



# LinSig

Version 2

## User Guide & Reference

Paul Moore  
Brian Simmonite  
Douglas Reid

**Software Development by**

Peter Cheng  
Jim Ching  
James Townsend  
Paul Moore

© JCT Consultancy Ltd 2007

JCT Consultancy Ltd.  
Units 4-5,  
22 The Green,  
Nettleham,  
Lincoln  
LN2 2NR

Tel: +44 (0)1522 754681

Fax: +44 (0)1522 753606

Email: [sales@jctconsultancy.co.uk](mailto:sales@jctconsultancy.co.uk) , [support@jctconsultancy.co.uk](mailto:support@jctconsultancy.co.uk)

Website: [www.jctconsultancy.co.uk](http://www.jctconsultancy.co.uk)

*This User Guide is Copyright of JCT Consultancy Ltd (2007). All copying of this document is prohibited except in the following circumstances:*

- *Licensed Users of LinSig Version 2 and unlicensed users may copy a single copy of the document to their computer when installing the software.*
- *Licensed users of LinSig Version 2 may copy this document within their own company an unlimited number of times provided it is copied in full and no fee or other charge is made for any copies.*
- *Employees of licensed users of LinSig Version 2 may make a single copy of this document for use at home provided it is only used for personal study or in connection with their employers business.*
- *Licensed users of LinSig Version 2 may use small extracts from the document for use in technical reports provided the source of the extract is fully acknowledged. This does not include course notes used for commercial training.*

*All Requests for copying other than the above should be made to JCT Consultancy Ltd.*

*Windows, Windows 98, Windows 2000, Windows XP, Windows Vista, Microsoft Office, Word, Excel and PowerPoint are registered trademarks of Microsoft Corporation.*

*WinZip is a registered trademark of WinZip International LLC.*

*SCOOT is a registered trademark of Siemens Plc, TRL Limited and Peek Traffic Ltd.*

# Contents

1. Introduction .....	1
1.1. What is LinSig? .....	1
1.2. What's New in Version 2 of LinSig .....	2
1.2.1. Traffic Model Improvements .....	2
1.2.2. Traffic Signal Controller Model Improvements.....	3
1.2.3. User Interface Improvements .....	4
1.2.4. Reporting Improvements .....	4
1.3. Software Support.....	5
1.3.1. Accessing Software Support.....	5
1.4. Training .....	6
2. LinSig Basics .....	7
2.1. Definitions.....	7
2.2. Working with LinSig Files .....	9
2.2.1. Creating a new LinSig File.....	9
2.2.2. Opening an existing LinSig V2 File.....	9
2.2.3. Saving LinSig Files .....	9
2.2.4. Importing a LinSig Version One File .....	9
2.3. The LinSig User Interface.....	11
2.3.1. Useful User Interface concepts.....	11
2.3.2. New User Interface Concepts in LinSig V2 to Watch Out For .....	12
2.3.3. Key LinSig User Interface Components.....	12
2.4. The LinSig Modelling Process.....	16
3. View Reference.....	20
3.1. General View Features.....	21
3.1.1. Always on Top .....	21
3.1.2. Zoom and Pan .....	21
3.1.3. Colours and Visual Settings.....	21
3.2. Junction Layout View .....	23
3.2.1. Definitions .....	23
3.2.2. Junction Building Overview.....	24
3.2.3. Displaying Numerical Information in the Junction Layout View .....	25
3.2.4. Working with Arms.....	27
3.2.5. Working with Lanes and Links .....	28
3.2.6. Joining Links with Link Connectors.....	47
3.2.7. Defining Network Entry and Exit Points using Zones .....	50
3.2.8. Displaying Signal Staging on the Junction Layout View .....	53
3.2.9. Annotating the Junction Layout View.....	55
3.2.10. Displaying and Using Timing Dials .....	57
3.2.11. Displaying Link Bandwidths on the Junction Layout View .....	59
3.3. Traffic Flows View .....	61
3.3.1. Defining Traffic Flows in LinSig .....	61
3.3.2. Using the Traffic Flows View .....	62
3.4. Phase View .....	72
3.4.1. Single Stage Stream Use .....	72
3.4.2. Using Multiple Stage Streams with the Phase View .....	75
3.5. Intergreen View .....	78
3.6. Stage View .....	80
3.6.1. Single Stage Stream Use .....	80
3.6.2. Using Multiple Stage Streams with the Stage View .....	82
3.7. Staging Plan View .....	85
3.7.1. Single Stage Stream Use .....	85
3.7.2. Using Multiple Stage Streams with the Staging Plan View .....	89

3.8. Scenario View .....	92
3.8.1. Working with Scenarios .....	92
3.9. Signal Timings View .....	96
3.9.1. Multiple & Single Stage Stream Use.....	96
3.10. Interstage View.....	101
3.10.1. Single and Multiple Stage Stream Use .....	101
3.11. Multiple Interstages View .....	110
3.12. Phase Data View .....	112
3.13. Stage Minimums View .....	113
3.14. SCOOT Data Preparation View.....	114
3.15. Link Results View .....	116
3.16. Cycle Time Optimisation View.....	122
3.17. Flow Profiles View .....	124
3.17.1. Flow Profile Graphs .....	125
3.17.2. Uniform Queue Graphs.....	130
3.18. Error View.....	131
3.19. Animating LinSig Views.....	133
3.19.1. Controlling the Animation.....	133
3.19.2. Viewing Animation in the Junction Layout View .....	134
3.19.3. Viewing Animation in the Phase View .....	134
3.19.4. Viewing Animation in the Staging Plan View. ....	135
3.19.5. Viewing Animation in the Signal Timings View .....	135
4. Modelling Background .....	136
4.1. The Basic LinSig Traffic Model.....	136
4.2. Give-Way Links in LinSig .....	144
4.2.1. The LinSig Give Way Model .....	144
4.2.2. The LinSig Right Turn Model .....	145
5. Controller Background .....	149
5.1.1. Phase Minimums .....	149
5.1.2. Phase Intergreens .....	150
6. Reporting and Printing .....	152
6.1. Printing Graphical Layout Views .....	152
6.2. Printing Multiple Interstage and Flow Profile Diagrams.....	154
6.3. The LinSig Report Builder .....	154
6.3.1. Report Definitions and Templates .....	155
6.3.2. Quickly Printing a Default Report.....	155
6.3.3. Using the Report Builder.....	156
6.3.4. Viewing and Printing a Report .....	162
6.4. Exporting Graphics.....	163
6.4.1. Exporting a View to CAD .....	163
6.4.2. Exporting Views to DTP and Word Processors .....	163
7. Examples .....	164
7.1. Link Structure Examples .....	164
7.1.1. Example 1 – Grouping Lanes into a single Link .....	164
7.1.2. Example 2 – Exclusive Lanes.....	165
7.1.3. Example 3 – Flared Entry .....	166
7.1.4. Example 4 – Left Turn Bay .....	167
7.1.5. Example 5 – Left Turn Give Way .....	168
7.1.6. Example 6 – Right Turn Opposed Movement at Signals.....	170
7.1.7. Example 7 - Mixed Right Turn Opposed Movements and Ahead Traffic in a single lane.....	173
7.1.8. Example 8 - Mixed Right Turn Opposed Movements and Ahead Traffic in Multiple Lanes. ....	177
7.1.9. Example 9 - Mixed Right Turn Opposed Movements and Ahead Traffic in Multiple Flared Lanes.....	178

A. Appendix A - Installation and Setup .....	180
A.1. Hardware Requirements .....	180
A.2. Software Requirements .....	180
A.3. Installing LinSig .....	181
A.4. Activating the LinSig Software Licence.....	181
A.4.1. Definitions.....	181
A.4.2. Product Activation for Individual PCs .....	182
A.4.3. Product Activation for Unlimited Networked PC Licences .....	186
A.5. Obtaining and Installing Updates to LinSig .....	188

# 1. Introduction

Welcome to the LinSig Version 2 User Guide. This User Guide aims to provide you with detailed information on learning and using the software. The User Guide is structured as follows:

1. **Introduction.** Provides an overview of the software, improvements in the latest version and information on training and software support.
2. **LinSig Basics.** Provides preliminary information on a range of LinSig issues including important definitions, a suggested sequence of working and a summary of the user interface. It is suggested that as a minimum new users read this section before using LinSig. For those users upgrading from LinSig V1, this section is recommended as a concise introduction to the features that are new to LinSig V2.
3. **LinSig Views Reference.** Provides detailed information on each LinSig View and how to use it. This section should be used both to gain detailed knowledge of LinSig and for quick reference to specific facts and details.
4. **Modelling Background.** Provides further detail and background on the modelling techniques used in LinSig.
5. **Controller Background.** Provides further detail and background on some characteristics of traffic signal controllers relevant to LinSig.
6. **Reporting and Printing.** Describes how to produce reports and printed output from LinSig.
7. **Examples.** A number of examples showing how to code different junction and Link types into LinSig.

## Appendices

- A. **Installation and Setup.** Provides detailed information on how to install, activate and setup LinSig, including how to setup Network Licence Servers. You do not need to read this section if LinSig was set up for you.

## 1.1. What is LinSig?

LinSig is a computer software package for the assessment and design of traffic signal junctions either individually or as a network comprised of a number of junctions. It is used by traffic engineers to construct a model of the junction or network which can then be used to assess different designs and methods of operation. Apart from stand-alone junctions, it can be used for multiple traffic signal junctions, signalled roundabouts, and also road networks which may include traffic signal pedestrian crossings and priority junctions as well as other traffic signal junctions.

LinSig has been available in a number of versions since 1985, and is the original software package for UK detailed traffic signal design. The software is used by the majority of UK highway authorities and consultants at several hundred locations, making it the most widely used traffic signal software in the UK. Throughout its life it has been regularly and extensively upgraded, including several complete rewrites, as computer technology and user requirements have changed and evolved.

The idea behind LinSig is straightforward in that it models traffic signal junctions in a similar way to how a real traffic signal controller actually works. This means that LinSig takes account of the features and constraints of the controlling equipment, thereby ensuring that all modelling accurately reflects how existing junctions work, and how any design proposals would operate if implemented.

## **1.2. What's New in Version 2 of LinSig**

LinSig for Windows Version 2 was released in 2006 and introduced a number of major new features. These include:

### **1.2.1. Traffic Model Improvements**

From the outset in 1985 LinSig has used the Webster and Cobbe method for predicting traffic capacities, queues and delays. Although this method continues to be widely accepted, it cannot deal with platooned vehicle movements through successive stop lines. This is an increasing feature of traffic signal design, and arises with more than one intersection area, displaced pedestrian crossings or signalled roundabouts. Dealing with successive stop lines is also essential in modelling networks of traffic signal junctions, and addressing this was key to improving the traffic model in LinSig.

Some of the key objectives of the improved model were:

- Model the effects of coordination between closely spaced successive stop lines.
- Model vehicle platoon shapes accurately allowing more robust coordination calculations to be made.
- For continuity remain as far as possible consistent with the Webster & Cobbe method except where changes are necessary to make justified improvements.
- Attempt to produce results consistent with established software such as TRANSYT to reduce unnecessary differences in results when comparing models.
- Improve the modelling accuracy of right turning traffic which is often critical in assessments and practical junction design.

A new traffic model was developed to fulfil the above objectives.

#### **1.2.1.1. New Linked Stop Line Traffic Model**

One of the most significant changes in LinSig V2 is the move away from the Webster & Cobbe style traffic model after over 20 years of use. LinSig V2 includes a completely new traffic model which is similar in style to the type of traffic model used in established network models such as TRANSYT and SATURN, but has been enhanced to provide more detail in a number of areas. LinSig uses flow profiles to model the shape of vehicle platoons allowing the coordination between successive stop lines to be modelled in detail thereby improving LinSig's modelling of groups of multiple junctions. LinSig models can also be extended to model small networks providing detailed analysis and sophisticated tools for investigating the performance of a network.

#### **1.2.1.2. Improved Right Turn Model**

An inherent problem with the old Webster & Cobbe method was the difficulty of modelling the blocking effects of right turning traffic sharing lanes with ahead traffic. The new right turn model predicts not only the intermittent obstruction of ahead traffic by opposed right turners sharing the same lane, but also equivalent blocking by vehicles overflowing a right turn bay. The latter consists of an exclusive right turn lane, but may not be of sufficient storage length for the numbers of vehicles per cycle waiting to turn right.

#### **1.2.1.3. Traffic Flow Specification using Origin-Destination Matrices and Detailed Routing Patterns**

In previous versions of LinSig traffic flows were specified separately for each Link. As LinSig V2 allows the modelling networks with potentially large numbers of Links, the existing Link

based method of entering traffic flow information would have been time consuming and prone to error. A new more sophisticated way of specifying traffic flows has therefore been developed to streamline the process. LinSig V2 allows an Origin-Destination (OD) Matrix to be entered for the whole model specifying traffic movements through the network whether it is a single traffic signal junction or a network of junctions. Traffic can then be allocated to Routes between the networks entries and exits. These are then used to determine the flow on each model Link. This new method allows a highly detailed picture of traffic movements to be built up which in turn allows the modelling of platoons to be detailed and accurate but with minimum complexity exposed to the user.

#### **1.2.1.4. Calculated Traffic Flow Groups**

LinSig uses Traffic Flow Groups to represent different times of day, development scenarios, or future assessment years. Often a Flow Group is calculated as a combination of several other Flow Groups, for example, Base Traffic added to Development Traffic. Previously in LinSig Flow Group combinations had to be calculated manually by the user which could lead to substantial recalculation and editing if a revision affected many dependent Flow Groups. To assist with such changes automatically calculated Flow Groups have been introduced. A new Flow Group can be defined using a mathematical equation to combine other Flow Groups. When a base Flow Group is changed all dependent Flow Groups are then automatically recalculated.

#### **1.2.1.5. Batch Modelling using Scenarios**

Version 2.4 of LinSig introduces a new feature allowing batch model recalculation and optimisation of a list of scenarios. The new scenario view can be used to define a list of different model scenarios specifying information such as traffic flow group, signal staging plan, cycle time etc. LinSig can then optimise the entire list of scenarios in one operation rather than having to optimise each scenario individually which was previously time consuming and prone to error. This is particularly useful when modelling Transport Assessments and other projects with many variants.

### ***1.2.2. Traffic Signal Controller Model Improvements***

One of LinSig's unique original features has always been its incorporation of a detailed traffic signal controller model similar to a UK TR2210/TR2500 specification controller. LinSig V2 improves on the existing model by adding a number of new features as follows:

#### **1.2.2.1. Multiple Stage Streams**

The use of multiple parallel Stage Streams is becoming more common in designs for complex signal junctions. LinSig can now explicitly model multiple independent stage streams on the same traffic signal controller allowing the controller design for the junction(s) to be fully developed within the LinSig model. This is considered essential for multiple traffic signal junctions and signalled roundabouts which often require a number of separate Stage Streams.

#### **1.2.2.2. Staging Plan Library**

With the advent of multiple Stage Streams the staging combinations which can be designed in LinSig V2 have the potential to be much more complex than in previous versions. To help manage different staging arrangements, LinSig now includes a Staging Plan Library which can be used to build and store however many sets of staging are needed for the junction or network. Each Staging Plan includes a stage sequence for the junction, or for each stage stream where multiple streams are used. This makes it very easy to store and retrieve

different Staging Plan options, for example with and without right turn arrows, and to quickly switch between them.

### **1.2.2.3. Phase Based Design Editor**

The new Phase Based Design Editor implements an alternative design methodology for designing traffic signal staging and sequences. The technique can enable a more efficient staging arrangement to be devised, but is quite complicated and demanding to implement by hand and in the past has not been widely used. The new version of LinSig introduces a graphical signal sequence editor which removes much of the legwork previously necessary when using this methodology, but still allows the design decisions to be made by the engineer. The editor allows the desired phase design of the junction to be defined freeform with little regard to stages. LinSig will then analyse the phase structure determining the stages required to implement the design.

### **1.2.2.4. SCOOT Configuration Data Calculator**

LinSig models are often used as part of the process of designing a junction which will be run under SCOOT or Urban Traffic Control (UTC) systems. The new SCOOT Configuration Data Calculator provides additional help with this process by using the LinSig controller model to calculate a range of data needed when configuring the SCOOT database. This allows junction design changes to be quickly incorporated into SCOOT.

### **1.2.2.5. International Controller Model Support**

Some countries or regions, for example, the Republic of Ireland and the Channel Islands use traffic signal systems very similar to the UK but with a number of minor differences unique to each region. Wherever possible, support for country specific controller features has been incorporated into this version of LinSig. If there are any further features specific to your country which are not yet implemented in LinSig please let us know so we can consider them for inclusion.

## ***1.2.3. User Interface Improvements***

The new version incorporates many user interface improvements into LinSig. These include detailed graphical views, the ability to easily zoom and pan views, toolbars, customisable colours and text sizes, a wider range of text display options, and customisable junction layout grids with snap-to-grid facilities. Although many of these enhancements are minor on their own, together they significantly improve the ease with which models can be prepared and presented.

Two further major editing improvements are the new Error View and multi-step undo. The Error View constantly checks the LinSig model for errors or warnings, reporting any found to the user. It acts as a central 'To Do Checklist' listing any parts of the model which are incomplete or may require further checking. The Undo facility allows any action taken in LinSig to be reversed. Any number of previous steps can be stepped through allowing 'experiments' with the model to be easily rolled back.

## ***1.2.4. Reporting Improvements***

### **1.2.4.1. Report Builder**

LinSig now includes a completely new report builder which produces comprehensive and detailed reports, including text, graphics and tables, in a format compatible with most modern word processors. The Report Builder allows a portfolio of custom report templates to be built up, each of which can be saved and distributed to other users to assist with standardisation of report formatting within an organisation. The reports can contain tables

and also graphics based on LinSig's graphical Views. Reports can be quickly rerun for different design scenarios allowing design or other changes to be rapidly incorporated.

#### **1.2.4.2. Graphics Export Facilities**

Often the graphical components of a LinSig report may need to be enhanced and added to before being used for presentation. Apart from word processing a report, LinSig V2 allows graphical views to be exported to a number of formats, including DXF CAD format, for import into graphics and CAD software for further editing. Graphics can also be cut and pasted via the clipboard for easy insertion into other software.

### **1.3. Software Support**

Full Software Support for LinSig 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 LinSig.
- Basic design advice for schemes being designed using LinSig. A full consultancy service is available at additional cost if more detailed advice is required.
- Free access to the LinSig Software Support Web Site. This web site includes advice on using the software, frequently asked questions (FAQs) and news of software updates.
- Free software updates which can be downloaded from the LinSig Software Support website. These include both bug fixes and minor feature updates. Major new versions are not included.
- Discounts off major new versions of LinSig.
- Free attendance at LinSig User Groups.

To register for your free 12 months software support please return the Software Support Agreement sent to you with LinSig. 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.

#### **1.3.1. Accessing Software Support**

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

- On our Web Site at [www.jctconsultancy.co.uk](http://www.jctconsultancy.co.uk)
- By Email at [support@jctconsultancy.co.uk](mailto: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

Please have your Licence ID handy before calling Software Support so we can validate your Software Support status. If emailing please include your Licence ID, Name, Office, Company and a contact telephone number in case we need to contact you to discuss the problem. Your Licence ID is available by choosing 'About LinSig...' from the Help menu.

## **1.4. Training**

JCT Consultancy Ltd. provides a wide range of training courses covering both the use of our software and general traffic signal design. For users converting from LinSig Version 1 to LinSig Version 2 upgrade courses will be run at a number of venues throughout the UK.

Full details of all our courses are available on our web site [www.jctconsultancy.co.uk](http://www.jctconsultancy.co.uk).

## 2. LinSig Basics

This section provides preliminary information on a range of LinSig issues including important definitions, a suggested sequence of working and a summary of the user interface. It is suggested new users read this section before using LinSig. It would also be useful for upgrading LinSig V1 users to review the section as it concisely introduces a number of topics new to LinSig V2.

### 2.1. Definitions

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

- **LinSig Network.** The LinSig Network describes the road network being modelled in a single LinSig file. The network size is in theory unlimited but is practically constrained by the time taken for LinSig to recalculate the traffic model and to optimise the signal timings. There is also a limit of a single traffic signal controller per Network (which can have multiple stage streams) in the standard version of LinSig. The Network uses Arms, Links and Lanes to describe the road Network being modelled.
- **Arm Group.** An Arm Group is a grouping of Arms used to graphically manipulate a number of Arms, for example all the Arms at a single Junction, together as a group. Arm Groups take no part in traffic model calculations.
- **Arms.** Each Arm represents a one-way section of road forming part of the Network. Each Arm contains a number of Links describing how traffic moves and behaves on that Arm. Arms are not involved in traffic model calculations.
- **Links.** The Link is the most important element of the Network and represents an independent stream of traffic, often a single lane, at the stop line at the end of an Arm. Due to the importance of Links in the correct modelling of capacity it is essential that Links are thoroughly understood. Each Link can contain a number of Lanes which are used to help define the Link's Saturation Flow Profile
- **Lanes.** Lanes are much less significant than Links. Each Lane belongs to an Arm but Lanes are also grouped together into Links where traffic using the Lanes on a Link can distribute equally between Lanes. The Lanes attached to a Link are principally used to define the Link's Saturation Flow Profile with the Link carrying out most of the modelling. Much more information on Links and Lanes is provided in the Junction Layout View section.
- **Link Connectors.** Link Connectors join each Link to Links on other Arms that are allowed to provide or receive traffic to or from the Link. The Link Connectors model how road markings dictate the way traffic should flow between Links. When modelling a single junction, Link Connectors are only required to define permitted turning movements from a Link, by connecting a Link to Links on its Exit Arms.
- **Exit Arms.** As Arms in LinSig are all one-way it is necessary to provide Exit Arms to explicitly define the points where traffic leaves the network. As it is not important to model the behaviour of traffic exiting this Arm it is usually unnecessary to provide more than a single Link on each Exit Arm. Links can be connected to Links on Exit Arms using Link Connectors to define permitted turning movements.
- **Zones.** A Zone represents an origin and/or destination for traffic entering or leaving the Network. Currently each Zone is associated with an Entry Arm, an Exit Arm or

both. Internal Zones feeding traffic onto Links which are not on Entry or Exit Arms are not currently allowed.

- **Routes.** A Route represents a unique path through the Network from one Zone to another. As each Route is comprised of a sequence of individual Links and Link Connectors, a number of different Routes can exist between any two Zones. Each of the Routes represents a different choice of Links for drivers travelling between two Zones.
- **Origin-Destination Matrix.** Traffic Flows through the Network are represented by a matrix that specifies the traffic flow between two Zones. Currently all flows are specified in PCUs.
- **Desired Flow.** A Desired Flow is an Origin-Destination Flow specified by the user as a target for the Actual Flows.
- **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 LinSig based on the desired Origin-Destination Flows and assumptions regarding drivers' behaviour in choosing Routes through the Network.
- **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.
- **Phase.** A Phase in LinSig is the same definition as a Traffic Signal Controller Phase, which is a group of Signal heads all showing the same aspects to traffic or pedestrians. This is the UK definition of a Phase not the US definition (which confusingly is the same as a UK Stage!)
- **Stage.** A Stage in LinSig is the UK definition of a Stage – that is a group of Phases running together. A UK Stage is broadly equivalent to the US definition of Phase.
- **Stage Stream.** A Stage Stream is a separate set of Stages stored on a Controller which can be used to control a junction or portion of a junction. A single controller may have more than one Stage Stream to allow it to control more than one junction. Although the Stages are numbered they do not have to be run in numerical order. The sequence of Stages actually run is defined in a Staging Plan.
- **Staging Plan.** A Staging Plan is the sequence of Stages run for each Stage Stream. Staging Plans are saved in the LinSig file and can be reused at any point and can be used in more than one scenario.
- **Scenario.** A Scenario describes all the information needed to fully define a single LinSig model run. This includes the traffic flow group, the staging plan, the cycle time and the stage times.

## **2.2. Working with LinSig Files**

LinSig stores all the information relating to a Network in a single file. LinSig Version 2 introduced a new file format different to LinSig Version 1 which allowed the large amount of extra information used in V2 to be stored. These files retained the .LSG extension of earlier LinSig V1 files.

LinSig V2.4 added a further file format – the LinSig extensible file format – which will allow new features to be added to LinSig files in the future whilst still allowing the files to be opened in earlier versions of LinSig. This will avoid the problem of files prepared by users using the latest version being incompatible with earlier versions of LinSig whose users have not yet had chance to update to the latest version. Files saved in this new format have the extension '.lsgx' to distinguish them from earlier files. Please note that these new abilities only apply to future updates and .lsgx files therefore cannot be opened in versions of LinSig prior to Version 2.4. As the new .lsgx format is required to support a number of the new features introduced in Version 2.4 it is not possible to save files in the old .LSG format in Version 2.4 and above.

### **2.2.1. Creating a new LinSig File**

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

### **2.2.2. Opening an existing LinSig V2 File**

An existing file can be opened by choosing 'Open' from LinSig File menu. If a file is already open in LinSig it will be closed and you will be prompted to save any changes to the file as described below. LinSig 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 LinSig file is open, LinSig will not change the file on disk unless you explicitly choose to save it using 'save' or 'save as' as described below.

LinSig Version 2.4 and above introduces a new file format – the LinSig extensible format – as described above. Versions 2.3 and below have no knowledge of and cannot open the new .lsgx format. Version 2.4 can open both the old .LSG format and the new .lsgx format files but can only save files in the new .lsgx format.

### **2.2.3. Saving LinSig Files**

The LinSig 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 LinSig. Due to the many changes in the data used by LinSig V2 it is not possible to save files in LinSig V1 format.

LinSig Version 2.4 and above introduces a new file format – the LinSig extensible format – as described above. Versions 2.4 and above always save files in this new .lsgx format.

### **2.2.4. Importing a LinSig Version One File**

LinSig Version Two uses a new extended file format over that used by LinSig Version One. The new format allows the large amount of extra information which LinSig V2 uses to be stored. LinSig V2 can import an existing LinSig V1 file simply by opening the file within

LinSig V2. LinSig will detect that the file is a V1 file and use all the information in the old file. Essential new information which LinSig V1 files do not contain includes:

- Exit Arms.
- Link Connectors.
- Zones.
- Routes.
- Traffic Flow Origin-Destination Matrices.

The above information must be added to a LinSig V1 file before results can be obtained.

It is suggested the following sequence is followed after opening a LinSig V1 file. Further details on how to carry out each step are available from the Views Reference section.

- Add Exit Arms in the Junction Layout View.
- Join Links with Link Connectors in the Junction Layout View. For a single junction from a LinSig V1 file the Link Connectors will usually be used just to connect Entry Links to Exit Links.
- Review Lane Turning movements and Geometric Saturation Flow parameters if appropriate. LinSig V1 references turning movements in a different manner to V2 as Arms were considered two-way in LinSig V1. To assist with converting turning movements into LinSig V2 format, Version 2 imports the Version 1 turning movements even though they are technically incorrectly defined and displays them in red. These red Turning movements are not used in modelling and exist only until replaced with turning movements defined in the correct V2 manner using Exit Arms and Link Connectors.
- Add Zones in the Junction Layout View for each point traffic enters and leaves the Network. Each Zone caters for an Entry and an Exit.
- LinSig will create Routes automatically when Zones have been created.
- In the Traffic Flows View ensure the 'Automatically Allocate Flows to Route' button is selected.
- LinSig has created an empty Flow Group for each Flow Group existing in the LinSig V1 file. Enter Origin Destination Flows for each Flow Group in the OD Matrix. As the 'Automatically Allocate Flows to Route' option is selected LinSig will attempt to automatically assign the OD Matrix to Routes.
- Use the Route List pane of the Traffic Flows View to review the Route Flows.
- Use the Junction Layout View to review the Link Flows calculated from the Route Flows.
- Save the file in LinSig V2 format.

#### 2.2.4.1. Differences in Results between LinSig V1 and V2

Traffic model results will often be the same for LinSig V1 and V2. The main areas where differences may occur are:

- **Give-Way Links.** The Give Way Link model has been substantially improved and this may be reflected in differences in capacity calculated for Give Way Links. Where appropriate the new blocking model for right turns should be used to improve the modelling of a right turn Link. This may require changes in Link structure in some cases.

- **Delays on Oversaturated Links.** The LinSig V2 traffic model gives higher delay estimates than LinSig V1 for heavily oversaturated Links. Only Links with degrees of Saturation over around 105-110% will exhibit a significant increase which may be as high as 20-30%. . It should be remembered that delays on oversaturated Links are very sensitive to small changes or inaccuracies in input data so the delay changes are not as practically significant as may first appear.
- **Queuing.** LinSig V1 used a simpler Queue model which predicted the number of vehicles in the queue at the end of red. LinSig V2 predicts the maximum position of the back of the queue at the time the front of a discharging queue catches up with arriving traffic adding to the back of the queue. This will typically increase queuing by a small amount on undersaturated Links, the exact amount being dependent on the characteristics of the Link's capacity and arrival profiles. Oversaturated Queues are calculated from oversaturation delay and therefore will increase by a similar level as for delays on oversaturated Links. It should be remembered that queuing on oversaturated Links is very sensitive to small changes or inaccuracies in input data so the queuing increases are not as practically significant as may first appear.

Please contact Software Support if you would like assistance in interpreting changes in results in your model.

## 2.3. The LinSig User Interface

The LinSig 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.

### 2.3.1. Useful User Interface concepts

When editing the LinSig 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 LinSig. For example, Arms, Links, Lanes, Link Connectors, Zones, Routes, Phases, Stages etc are all 'Items'.
- **Selecting an Item.** Clicking on an item in a LinSig 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 Link' you must have selected a Link. 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 LinSig 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 to edit it 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 LinSig 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. Any number of previous commands can be undone and if necessary redone. The Undo History View can also be used to display the sequence of commands Undo will undo. Undo is only available for the duration of the editing session and cannot undo past the point when a LinSig model was opened.
- **Error View.** The Error View lists any errors and warnings in the LinSig model being developed. Each error is listed together with its location and severity allowing you to get an overview of any problems which require attention. This helps to avoid issues such as inadvertently forgetting to enter the Saturation Flow for a Link and not spotting the problem until after results have been used. Please remember though that the Error View is an aid – it is not an excuse to neglect proper scrutiny of your work and results. i.e. No errors in the Error View does not imply your model is right.
- **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 contains 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'.

### ***2.3.2. New User Interface Concepts in LinSig V2 to Watch Out For***

LinSig V2 makes a number of important additions and changes to the User Interface used in LinSig V1. Some of the most useful ones to watch out for include:

- **Multi-Stage Streams.** LinSig now allows the Controller Model to be developed using multiple Stage Streams. This can be very useful for more complex junctions as LinSig allows you to work with multiple Streams in a number of the Controller related Views such as the Stage View, Staging Plan View and Signal Timings View. However, as many straightforward junctions only require a single Stage Stream LinSig can be switched into 'Single Stage Stream' mode (File...Document Settings...Multiple Streams) which will simplify the Controller Views to display and edit just a single Stream.
- **Junction Layout View Lane/Link Data Display.** LinSig V2 allows numerical data to be shown on the Junction Layout View for Links and Lanes. For reasons of space and layout all the numerical data is actually shown on the Lanes. What data is shown is governed by user definable text formats which as well as specifying whether to show Lane or Link data also specify exactly which data to show.

### ***2.3.3. Key LinSig User Interface Components***

The LinSig user interface consists of the main program window, which contains the following Items. More detailed explanations of many items, including each View, are included in the reference section of this User Guide.

- **Main Menu.** The main menu is located along the top of the LinSig main Window and is the primary method for carrying out tasks in LinSig. Unless otherwise stated all tasks in LinSig 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 LinSig 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 LinSig model.
- **View Manager.** The View Manager allows arrangements of the different LinSig Views to be defined and saved. Different arrangements of views can then be recalled at any time depending on the current task being undertaken. For example one view arrangement may be defined positioning the views to allow easy entering of traffic flows whilst another may arrange the signal editing views.
- **Junction Layout View.** The Junction Layout View displays the overall layout of the Junction's Links and Lanes and how they interconnect. The View can be used to carry out the following tasks:
  - Create, delete and edit Arms, Links and Lanes.
  - Join Links together using Link Connectors.
  - Create, delete and edit Zones and connect them to Arms.
  - Display Link and Lane based input data and results.
  - Display mini-graphs of flow profiles and queues.
  - Display mini stage diagrams embedded in the View.
  - Examine and display routes selected in the Route List in the Traffic Flows View.
  - Allow signal times to be edited using timing dials.
  - Display flows as link bandwidths.
  - Display animated signal sequences.
- **Phase View.** The Phase View graphically displays the traffic signal controllers phase layout. The View can be used to:
  - Create, delete and edit Phases.
  - Create, delete and edit Stage Streams.
  - Define the Phases allocated to each Stage Stream.
- **Intergreen View.** The Intergreen View is used to enter and edit the Phase Intergreen matrix for the Controller model. The Intergreen Matrix's cells are colour coded to indicate cells where it may be inappropriate to have an intergreen, for example, where two phases are configured to run together in the same stage. This View can be used to carry out the following tasks:
  - Enter and edit Phase Intergreens.
  - View matrix cells where LinSig indicates an Intergreen would be incorrect.
- **Stage View.** The Stage View is used to construct Controller Stages which are subsequently used in the Staging Plan View to construct Signal Sequences for each Stream. The View can be used to carry out the following tasks:
  - Define the Phases allocated to each Stage Stream.
  - Create and delete Controller Stages.
  - Renumber Stages by reordering them with the mouse.
  - Add and remove Phases from a Stage by double clicking.
  - Use colour to display Phases which cannot run together due to Intergreens etc.

- **Staging Plan View.** The Staging Plan View is used to create and edit Staging Plans. Each Staging Plan defines the sequence of Stages being modelled for each Stage Stream. As many Staging Plans as desired can be created and quickly switched between. The Staging Plan View can be used to carry out the following tasks:
  - Create and delete Staging Plans.
  - Define the Stage sequence for each Stage Stream by dragging Stages from the Stage View.
  - Enter the Stage sequence for each stream by typing a numerical list of stages in the Sequence column of the Staging plan list.
  - Change the Stage Sequence for a Stream by reordering Stages with the mouse.
  
- **Interstage View.** The Interstage View allows a number of items relating to interstages to be viewed and edited. The View can be used to carry out the following tasks:
  - View Prohibited Stage Changes including ones prohibited automatically by LinSig.
  - Manually prohibit stage changes.
  - View the interstage duration matrix.
  - View the detailed structure of an Interstage.
  - Create, edit and delete Phase Delays in the Phase Delays table.
  - Graphically add, change or delete phase delays by dragging the start and finish points of phases with the mouse.
  - Automatically optimise the interstage using a user defined critical phase order.
  
- **Signal Timings View.** The Phase-Stage View is an important view which shows the times and durations of Stages and Phases in each Stream, as well as other information such as Interstage structure. The View can be used to carry out the following tasks:
  - View the Start and Finish times of Phases throughout a Signal Cycle.
  - View Stage Change Points and change them by dragging with the mouse.
  - Manage Stage Stream cycle times.
  - Optimise Stage length for individual Stage Streams.
  - View Intergreens and Interstage Structures.
  
- **Traffic Flow View.** The Traffic Flow View is used to define traffic flows using traffic flow groups and to allocate flows to LinSig Links. The View can be used to carry out the following tasks:
  - Create, delete and edit Traffic Flow Groups.
  - Enter the Desired Flows Matrix for each Flow Group.
  - View the Actual Flow and Difference Matrices for each Flow Group.
  - View, sort and edit routes in the Route List.
  - Automatically allocate the Desired Flows to routes through the network.
  - Make manual changes to the traffic flow allocated to each Route.
  - Highlight a Route in the Junction Layout View by selecting the Route in the Route List.

- Filter the Route List to display a sub-set of Routes in the Route List and in the Junction Layout View.
- **Link Results View.** The Link Results View displays a table showing detailed model results for each LINISIG model Link.
  - Rows can be sorted by clicking on the header above each row.
  - Columns can be added and removed by right-clicking on the column headers. This menu can also be used to abbreviate column headers to save space.
  - Tables showing a lot of Links can be filtered to display just a subset of Links.
- **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.
- **Cycle Time Optimisation View.** The Cycle Time Optimisation View displays the performance of the junction over a range of cycle times.
- **Phase Based Design Tool.** The Phase Based Design Tool graphically implements the advanced technique of Phase Based Design which can often lead to a much more efficient Stage design. The technique involves designing a signal sequence based purely on Phases without regard to Stages. This can be carried out graphically in the Phase Based Design Tool which assists by advising of, and where necessary enforcing, constraints such as intergreens and minimums. LinSig then analyses the resulting Phase structure to determine what Stages are required to implement it in the Controller.
- **Multiple Interstages View.** The Multiple Interstages View allows a number of Interstage diagrams to be laid out on a page and printed. This is particularly useful for preparing documentation for use in Controller Factory Acceptance Tests (FAT).
- **Stage Minimums View.** The Stage Minimums View displays the stage minimums for all possible combinations of preceding and succeeding stages. This information is useful when configuring remote monitoring and in some SCOOT applications.
- **SCOOT Data Preparation View.** The SCOOT Data Preparation View assists with the preparation of a SCOOT Database. The View allows SCOOT Stages to be defined in terms of one or more Controller Stages. LinSig then analyses all possible combinations of Controller Stages which affect SCOOT Interstage and Stage minimums, and reports the limits for Interstages and minimums for the controller which SCOOT may encounter.
- **Error View.** The Error View Lists all current Errors and Warning in the LinSig model together with their location. Errors indicate a fatal problem somewhere in the model whereas Warnings indicate only a possible problem which it would be wise to check.
- **Flow Profiles View.** The Flow Profiles View allows Link Flow Profiles graphs to be laid out on a page to be viewed or printed. Both Flow and queue profiles can be displayed and profiles can also be displayed disaggregated by Route to show the detail of different platoons passing through the Link. An alternative to the Flow Profiles View is to embed mini-Flow Profiles in the Junction Layout View.
- **Phase Data View.** The Phase Data View simply lists the phases currently defined in the Controller model together with input data and results for each Phase.
- **Undo History View.** The Undo History View displays all the previous editing steps and when they occurred in the current editing session. The View can be used to revert back to any point within the current editing session.

- **Link Data Grid View.** The Link Data Grid View displays Link data in a spreadsheet style grid view. Where possible data items can be edited directly on the grid allowing rapid bulk data changes albeit with a less informative user interface.
- **Lane Data Grid View.** The Lane Data Grid View allows Lane Data to be edited in a spreadsheet style grid similar to the Link Data View.

## 2.4. The LinSig Modelling Process

Although LinSig models can be built up in any order it is recommended when new to LinSig to follow the editing sequence described below. This will avoid inadvertently missing out any crucial steps or becoming 'lost' within the modelling process. The following is intended to be a quick review of how to build a LinSig model. Much more detail on the aspects covered is found elsewhere in this user Guide.

### 2.4.1.1. Network and Junction Layout

- **Add Entry and Exit Arms.** Using the Junction Layout View add Arms to lay out the Junction. All Arms in LinSig V2 are one-way and therefore each two-way road requires two Arms, one towards the Junction and one away from it. Where there is another Junction downstream the Arm away from the Junction will simply be an Arm at the next downstream Junction. Where the Junction is the only Junction modelled, or is at the edge of the Network, additional Arms are used to represent traffic exiting the Network. Each Exit Arm is an ordinary Arm containing its default single un-signalled Link which then passes traffic to its destination Zone.
- **Add Lanes to each Arm.** The way traffic behaves on each Arm is governed by the Lane and Link structure of the Arm. The Lane/Link structure is created in two stages: the Lanes are added first and then the Lanes are grouped together where appropriate using Links. Each Link represents a stream of traffic where vehicles can distribute equally between all Lanes in the Link. Initially Lanes are added to each Arm to describe the Lane structure of the Arm. The Lane structure should reflect how the Arm actually operates rather than its road markings. As Lanes are added LinSig will automatically create a new Link for each Arm. The Link structure is then refined in 'Refine the Link Structure for each Arm' below.
- **Set Lane Lengths.** Lane lengths for Short Lanes (A short lane is any lane not extending back to the upstream junction) can be set by double clicking on a Lane to open the 'Edit Lane' dialog box. Lane Arrows and Saturation Flows should NOT be entered at this point as it is better to sort out a good Lane/Link structure before entering all the other Lane/Link data. Short lanes associated with right turns which give way are modelled as part of their link and are not defined as separate Lanes.
- **Refine the Link Structure for each Arm.** This is the most important step in creating a LinSig model. Each Arm contains one or more Links, each Link grouping one or more Lanes. Each Link represents an independent queue or stream of traffic on that Arm. Initially LinSig creates each Lane with its own Link; however in some situations where a stream of traffic distributes over a number of Lanes these Lanes should be combined as a single Link. The most common scenario where this is necessary is when flared left turn lanes are required to be combined with their adjacent long lane. Significantly more detail on how to configure Links and Lanes is provided in the Junction Layout View Section.
- **Add Link Connectors between Links.** Link Connectors define which traffic movements are allowed between Links on different Arms. When modelling a single junction Link Connectors simply define which Exit Arms traffic from each Link may travel too. When modelling a more complex network with more than one junction Link

Connectors define how traffic can move from one Link to a downstream Link at the next junction. Link Connectors are added in the Junction Layout View by dragging with the mouse from one Link to another Link. A Link is shown in the Junction Layout View as a yellow or grey box containing the Link's number at the front of the Link and a black bar at the back of the Link.

- **Enter additional Lane Data and Saturation Flows on each Lane.** Each Lane should be edited in turn to define the turn arrows displayed on the Lane and the Lanes Saturation Flow. Saturation Flows can either be manually entered or calculated from the Lane's geometry.
- **Define Opposed Link Details for Opposed Links.** LinSig V2 uses a new right turn model which models right turning traffic with more accuracy and flexibility. Although a number of new parameters can be entered to model a wider variety of cases, standard opposed links containing no other movements can be defined by using defaults or parameter values from LinSig Version One. Further information on modelling right turns is provided in the Modelling Section.

#### 2.4.1.2. Traffic Signals

- **Add Traffic Signal Phases to the Controller Model.** The Phase View can be used to add Traffic Signal Phases to LinSig's Controller Model. Each Phase should be given an appropriate Phase Type, and Indicative Arrow and Filter Phases must have their associated Phases specified. The 'Street Minimum' specified for the Phase refers to the desired minimum observable on the street which may be different from the 'controller minimum' specified for the controller which will exclude Phase Losing Delays. As the Phases do not yet know what they are controlling the Phases will not yet show any directional arrows.
- **Edit Links to connect to Phases.** Now Phases exist each Link can be edited to specify its Controlling Phase. The Phases will now show directional arrows based on the turning movements allowed in Links controlled by the Phase.
- **Add Intergreens.** The Phase Intergreens should now be added to the Controller Model using the Intergreens View.
- **Add Stages.** Phases can now be grouped into Stages using the Stage View. Stages created in the Stage View represent Stages configured in the Controller and do not need to be in the order actually run. Phases can be added or removed from a Stage by double clicking. LinSig will prevent Phases from being added to a Stage if doing so would create a conflict between Phases. Where more than one Stage Stream is being used Phases must first be allocated to a Stage Stream by double clicking the phase in the Stream Box to the left of the Stage View.
- **Add Stages to Staging Plan.** Staging Plans are a new feature in LinSig V2 and take the place of the LinSig V1 Stage Sequence. The Staging Plans allow a separate Stage Sequence to be defined for each Stage Stream and can also be saved and recalled at any time allowing a library of Staging Plans to be created and easily re-run. Stages can be added to a Staging Plan by dragging Stages from the Stage View. Stages within the Staging Plan can also be reordered by dragging with the mouse. Alternatively a numerical Stage Sequence can be entered into the sequence column of the Staging Plan list.

#### 2.4.1.3. Traffic Flows and Routing

In LinSig V2 Traffic Flow Information is entered differently compared with LinSig V1. Traffic Flow Data is entered as an Origin-Destination (OD) Matrix. LinSig then uses Zones and Routes to assign the OD Matrix to Links in the Model to obtain Link Flows which are then

used in model calculations. As in LinSig V1, LinSig V2 can have any number of Traffic Flow Groups defined, and a separate OD Matrix is entered for each Flow Group.

- **Add Zones to the Junction Layout.** LinSig uses Zones to specify how traffic will enter and exit the modelled Network. Each Zone specifies an Entry Link and an Exit Link allowing differently numbered Entry and Exit Links to be labelled as a single Entry/Exit avoiding the need, for example, to remember that North Street may have traffic entering the Junction on Link 3 and exiting on Link 6. The Zones are also used in the Traffic Flow Origin-Destination (OD) matrix to specify Traffic Flows through the Network. Zones are added in the Junction Layout View by choosing 'Add Zone...' from the 'Junction' menu, before specifying the Zone's Entry and Exit Links.
- **Create Traffic Flow Groups** Flow Groups can be created and managed in the Traffic Flow View. A new feature in LinSig V2 allows Flow Groups to be defined as a combination of other Flow Groups using a formula to specify how they are combined.
- **Enter Traffic Flow Information into the Origin-Destination Matrix.** Traffic Flow information in LinSig is entered in Passenger Car Units (PCU) flows between Zones. The Traffic Flow View provides a Desired Flow OD Matrix in which the Traffic Flows for each Zone-to-Zone movement are entered. The Actual and Difference Matrices are used to display information not to enter data. This is described in more detail in Definitions on page 7 above.
- **Review the LinSig Routes.** LinSig uses Routes to define how OD Flows are assigned to the Network. A Route in LinSig is defined as a path of Links between two Zones. LinSig automatically creates all possible Routes through the Network and lists them in the Route List panel of the Traffic Flows View. The Route List can be used to examine Routes to check for sensible routing patterns and to manually edit Flows assigned to Routes as described below.
- **Allocate OD Movements to Routes.** For simple Networks LinSig can automatically allocate the OD movements to Routes using 'Allocate OD Flows to Routes...' on the 'Routes' menu. LinSig will attempt to distribute flows between Routes with the objective of equalising Link Flows on the Link where traffic enters the Network.
- **If necessary Fine Tune the Route Flow Distribution.** In cases where LinSig's estimate of Route Flows is not accurate enough, Route Flows can be manually changed to reflect uneven distribution of traffic between Routes. Route Flows can be edited by double clicking a Route in the Route List in the Traffic Flows View. The Actual and Difference Flow Matrices in the Traffic Flow View should be used to monitor the total Route Flows between Zones to ensure the total amount of traffic on Routes is the same as that specified in the Desired Flows Matrix.

Although the above process can be carried out quickly for smaller Networks, for versions of LinSig which allow larger Networks to be modelled further more sophisticated methods of flow allocation will be provided to assist with this process.

#### 2.4.1.4. Running the LinSig Model

- **Define Modelling Scenarios.** A Scenario associates together a Traffic Flow Group, Staging Plan, Cycle Time and Stage lengths providing LinSig with all the information it needs to calculate model results. Providing there are no errors in the model LinSig will always display model results for the current Scenario which can be selected from the main toolbar or in the Scenario View. LinSig will initially use random Stage Lengths but these can easily be changed for the current Scenario either manually using the Signal Timings View as detailed below, or automatically using the optimisation facilities. LinSig will then recalculate the model results for the new

scenario and Stage Lengths. The Scenario View can also be used to optimise a number of Scenarios at once as a batch.

- **Changing Signal Times using the Phase/Stage View.** The initial results displayed by LinSig will be calculated using an initial effectively random set of Stage Lengths for each Stage Stream. The current Stage times being used can be displayed using the Phase-Stage View which also shows the duration of Phases and details of Interstage structures. Stage Lengths can be easily changed by dragging Stage Change Points with the mouse. LinSig updates model results for the new stage lengths as the times are changed.
- **Checking for Errors using the Error View.** If Errors exist in the Model an indicator on the Status Bar at the bottom of the LinSig main Window will indicate so. The Error View can be opened by double clicking on the Error Indicator. This View lists all Errors and Warnings and wherever possible indicates their location. Errors prevent the model from calculating results, warnings allow results to be calculated but indicate that LinSig thinks some data or setting **may** be dubious and needs checking.

#### 2.4.1.5. Results

- **Link Result View.** The Link Results View displays a detailed table of performance results for each Link and also for the Network as a whole. The table can be sorted by clicking on any column header and columns can be added, removed and resized by right clicking on a column header.
- **Link Flow Profile Graphs.** As part of the Traffic Model Calculations LinSig calculates detailed traffic flow profiles of platoons passing through each Link. The flow profiles can be displayed either using the Flow Profiles View or embedded on the Junction Layout View. The Link Graphs are extremely useful in studying how traffic is using a Link and can assist with identifying any areas of the model where traffic isn't being modelled correctly. The Link Profile Graphs can also be embedded in the Junction Layout View.

#### 2.4.1.6. Signal Optimisation

- Signal Optimisation can be carried out to optimise each stage stream individually or to optimise the network as a whole. LinSig can optimise individual streams for either best PRC or minimum delay and can optimise the whole network for minimum delay. Whenever an optimisation is carried out the signal times are optimised for the currently selected Scenario.

### 3. View Reference

LinSig maintains a detailed model of the junctions being studied and the traffic signal controllers controlling these junctions. The model is displayed and edited using a series of Views. Each View displays the model in a different way or allows different aspects of the model to be worked on.

The LinSig Views were introduced briefly in 'Section 3 – LinSig Basics' where their purposes are briefly summarised. This section covers each View in more detail describing how they are used to edit the model and to interpret results.

The LinSig Network Views are:

- **Junction Layout View.**
- **Traffic Flow View.**

The Controller Views are:

- **Phase View.**
- **Intergreen View.**
- **Stage View.**
- **Staging Plan View.**
- **Interstage View.**
- **Signal Timings View.**
- **Multiple Interstages View.**
- **Phase Data View.**
- **Stage Minimums View.**
- **SCOOT Data Preparation View.**
- **Phase Based Design Tool.**

The Results and Reporting Views are:

- **Scenario View.**
- **Link Results View.**
- **Cycle Time Optimisation View.**
- **The Report Builder.**
- **Flow Profiles View.**

Other Miscellaneous Views:

- **Error View.**
- **Undo History View.**
- **Link Data Grid View.**
- **Lane Data Grid View.**

## 3.1. General View Features

Some features are common to a number of Views.

### 3.1.1. Always on Top

**Applies to:** All Views

The 'Always on top' feature allows a View to be kept on top of all other Views. This is useful if you wish to prevent a smaller View becoming lost behind a larger View. 'Always on Top' can be switched on for a view by clicking the 'pin' icon located to the right of each View's Title Bar.



**Always on Top Off**



**Always on Top On**

If two overlapping Views are both set to always on top the most recently used View will be on top.

Tip: Avoid having a large View with 'Always on Top' switched on as it is very easy to lose smaller Views behind it.

### 3.1.2. Zoom and Pan

**Applies to:** Junction Layout View, Phase View – Zoom & Pan.

**Stage View, Staging Plan View – Zoom Only.**

The main graphical layout Views can be zoomed and panned using both the toolbars and the mouse. Zooming can be carried out using the zoom toolbar located on the main toolbar of each of the zoomable Views.



**Zoom Toolbar**

The toolbar allows the View to be zoomed in and out, and also using the left button zoomed to fit the View to its contents.

If your mouse is equipped with a mouse wheel the zoomable views can be rapidly zoomed by scrolling the mouse wheel backwards and forwards.

### 3.1.3. Colours and Visual Settings

**Applies to:** All Views

The Colours, Font, Text Sizes and other visual settings can usually be altered for items displayed in Views. Generally it is recommended to retain the default colours unless a good

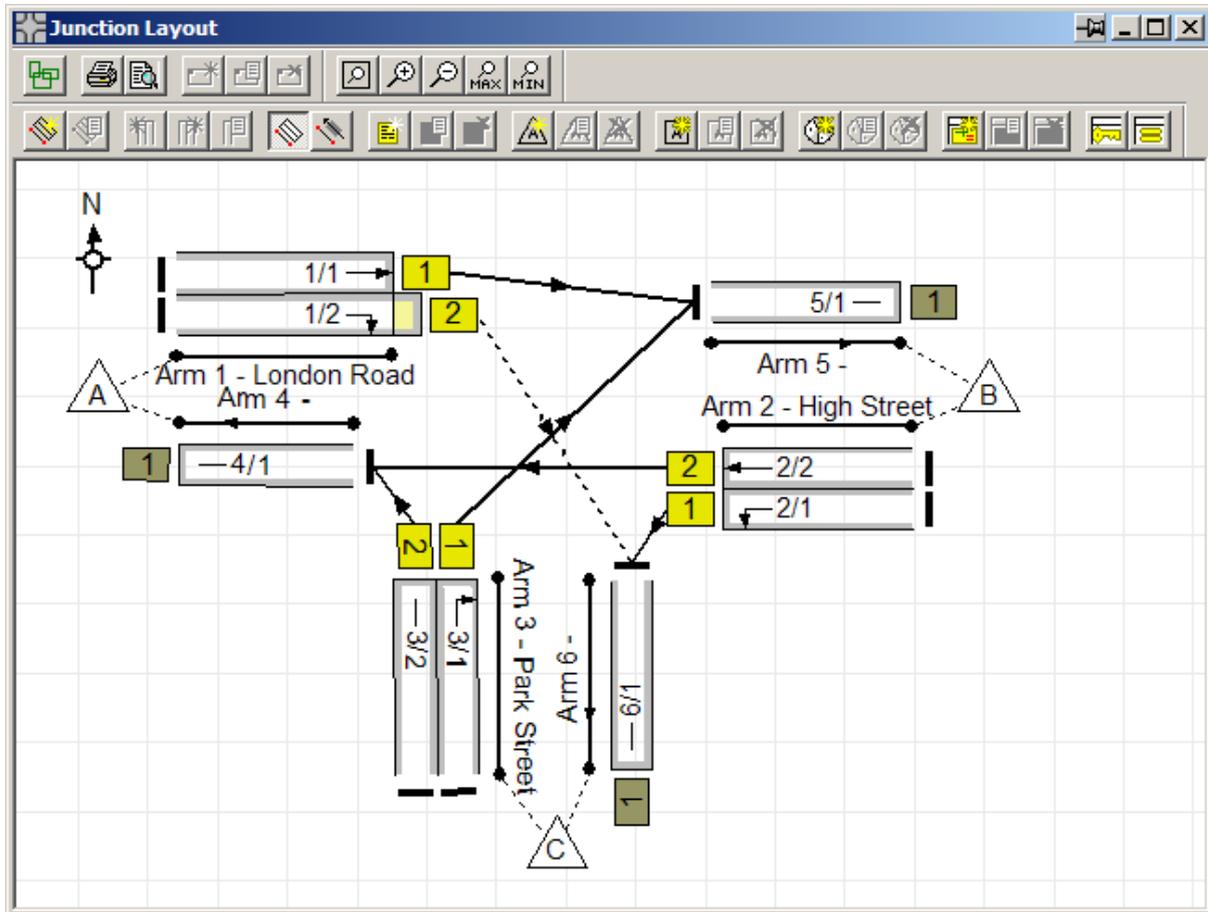
reason to change them arises as this will avoid confusion between different users. This User Guide assumes that colours are set to default when referring to the colour of items and objects.

Visual settings are split into groups. These are:

- **File Specific Settings.** These settings are located on the 'Graphical Settings' tab of the 'Settings for This File' dialog box. This can be opened by choosing 'Settings for This File' from the File menu. The tab contains settings which relate to the layout of the Junction Layout View and other Views which are likely to be specific to an individual file rather than for a user. For example, a very detailed network may look better with a smaller text size or narrower lanes. These settings are therefore stored in the LinSig file so they are used whenever the file is opened by any user.
- **Default Settings for New Files.** The Default Settings for new files are located on the 'Defaults for New Files' and 'Graphical Defaults for New Files' tabs of the 'Defaults for New Files' dialog box. This is opened by choosing 'Defaults for New Files' from the File menu. These settings only apply to new files created in LinSig and once set avoid the need to setup your preferred File Specific Settings in each new file.
- **User Graphics Settings.** These settings are located on the 'Graphics Options' and 'Colour Options' tabs of the 'Graphics Settings' dialog box. This is opened by choosing 'Graphics Settings...' from the File menu. The User Graphics Settings affect display issues such as colours, line thicknesses and font sizes which do not affect the Junction Layout and can therefore be specified by personal preference rather than being tied to each file. Each LinSig file opened will be displayed using the User Graphics Settings.
- **Program Settings.** These settings are located in the 'Program Options' dialog box which is opened by choosing 'Program Settings...' from the File menu. The Program Settings affect a number of aspects regarding the way LinSig operates, such as Auto-updates and Auto-save.

## 3.2. Junction Layout View

The Junction Layout View is the most important View in LinSig. The View is used to build a detailed model of the Junction's geometric structure and layout. This is carried out by combining components such as Arms, Links, Lanes and Zones to define the Junction's layout and to specify how traffic can flow through the Junction.



### 3.2.1. Definitions

A range of LinSig items were defined in 'Definitions' in the 'LinSig Basics' chapter. It is however worth revisiting them here:

- **LinSig Network.** The LinSig Network describes the road network being modelled in a single LinSig file. The network size is in theory unlimited but is practically constrained by the time taken for LinSig to recalculate the traffic model and to optimise the signal timings. There is also a limit of a single traffic signal controller per Network (which can have multiple stage streams) in the standard version of LinSig. The Network uses Arms, Links and Lanes to describe the road Network being modelled.
- **Arm Group.** An Arm Group is a grouping of Arms used to graphically manipulate a number of Arms, for example all the Arms at a single Junction, together as a group. Arm Groups take no part in traffic model calculations.
- **Arms.** Each Arm represents a one-way section of road forming part of the Network. Each Arm contains a number of Links describing how traffic moves and behaves on that Arm. Arms are not involved in traffic model calculations.

- **Links.** The Link is the most important element of the Network and represents an independent stream of traffic, often a single lane, at the stop line at the end of an Arm. Due to the importance of Links in the correct modelling of capacity it is essential that Links are thoroughly understood. Each Link can contain a number of Lanes which are used to help define the Link's Saturation Flow Profile
- **Lanes.** Lanes are much less significant than Links. Each Lane belongs to an Arm but Lanes are also grouped together into Links where traffic using the Lanes on a Link can distribute equally between Lanes. The Lanes attached to a Link are principally used to define the Link's Saturation Flow Profile with the Link carrying out most of the modelling. Much more information on Links and Lanes is provided in the Junction Layout View section.
- **Link Connectors.** Link Connectors join each Link to Links on other Arms that are allowed to provide or receive traffic to or from the Link. The Link Connectors model how road markings dictate the way traffic should flow between Links. When modelling a single junction, Link Connectors are only required to define permitted turning movements from a Link, by connecting a Link to Links on its Exit Arms.
- **Exit Arms.** As Arms in LinSig are all one-way it is necessary to provide Exit Arms to explicitly define the points where traffic leaves the network. As it is not important to model the behaviour of traffic exiting this Arm it is usually unnecessary to provide more than a single Link on each Exit Arm. Links can be connected to Links on Exit Arms using Link Connectors to define permitted turning movements.
- **Zones.** A Zone represents an origin and/or destination for traffic entering or leaving the Network. Currently each Zone is associated with an Entry Arm, an Exit Arm or both. Internal Zones feeding traffic onto Links which are not on Entry or Exit Arms are not currently allowed.
- **Routes.** A Route represents a unique path through the Network from one Zone to another. As each Route is comprised of a sequence of individual Links and Link Connectors, a number of different Routes can exist between any two Zones. Each of the Routes represents a different choice of Links for drivers travelling between two Zones.

### **3.2.2. Junction Building Overview**

The section 'The LinSig Modelling Process' in the 'LinSig Basics' chapter describes a suggested sequence of steps for building a LinSig model. The Junction Layout View is used at a number of steps in this process. The key tasks carried out in the Junction Layout View are:

- Lay out the Junction using one-way Arms, including Exit Arms where traffic leaves the Junction. Optionally Arms can be grouped together as an Arm Group to allow them to be graphically manipulated as a group.
- Add Lanes to each Arm to reflect the lane layout within the junction.
- Decide on the Link structure for each Arm and where appropriate group Lanes together into Links.
- Join Links on different Arms using Link Connectors.
- Edit Lanes to set Saturation Flows and other Lane based data.
- Edit Links to specify Link data such as Opposed Link give-way parameters.
- Add Zones to define the entry and exit points for the Junction.

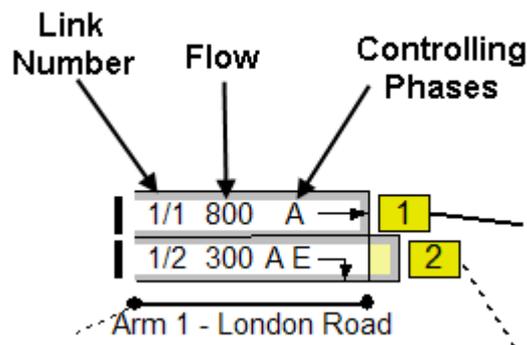
- Set up the LinSig Controller Model using other Views before returning to the Junction Layout View to specify each Link's controlling Phase(s).
- Use the Junction Layout View to display results as text and profile graphs.

This section describes how to use the Junction Layout View to carry out the above tasks but does not cover modelling issues such as determining the best Link Structure to model different scenarios. Modelling issues are covered in much more detail in the 'Modelling Background' section.

### 3.2.3. Displaying Numerical Information in the Junction Layout View

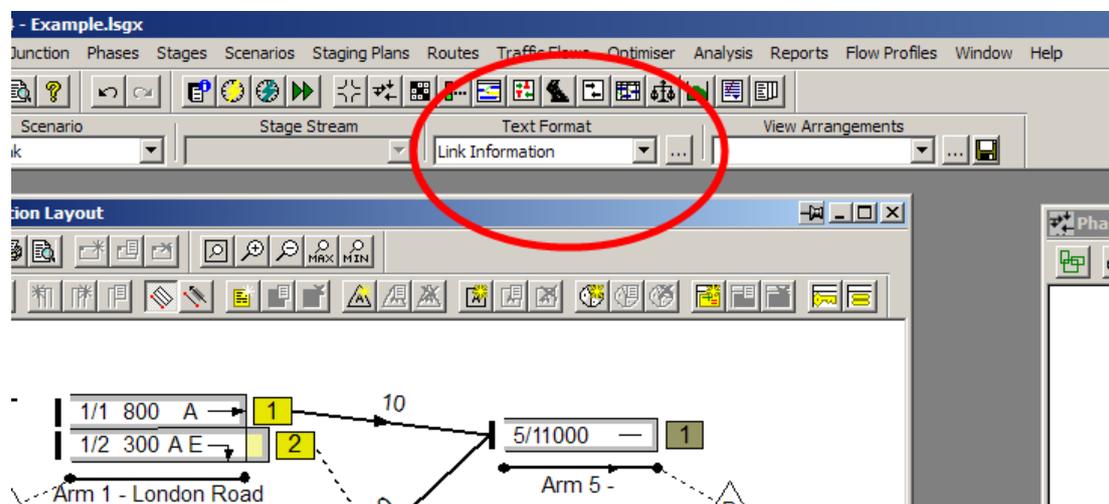
The Junction Layout View can display numerical information relating to Links and Link Connectors or to Lanes. As LinSig uses far more input data and results than can be displayed at once different Text Display Formats are used to display different sets of information at different times. LinSig provides a range of pre-defined Text Display Formats but it is also possible to create any number of user defined Text Display Formats.

Each Link or Lane can display up to three data or result items: one at each end and one in the middle as illustrated below. Each Text Display Format specifies whether Link or Lane data is to be displayed and which data or results appear in each position. A single data item can also be displayed on Link Connectors. Where a Link contains more than one Lane the Link data is shown in the centre of the Link's Lanes to avoid confusion between Link and Lane data. An example of a typical display is shown below.



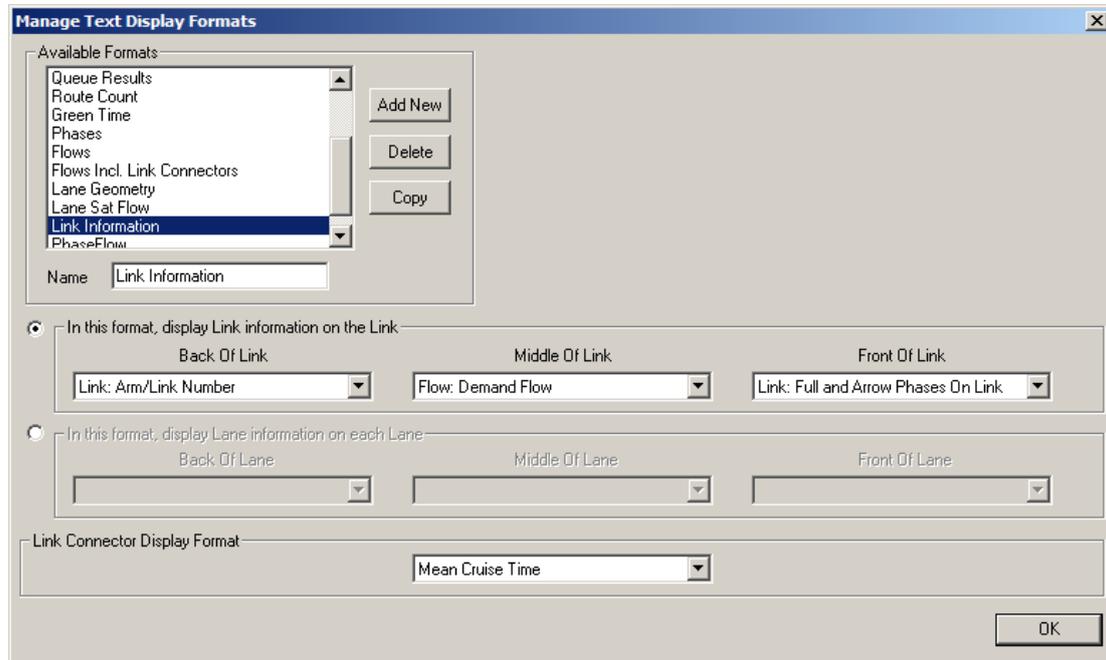
#### 3.2.3.1. Choosing the Text Display Format

The Text Display Format can be selected using the drop down list of Text Display Formats in the toolbar.



### 3.2.3.2. Creating Customised Text Display Formats

New Text Display Formats can be defined using the Text Display Format Manager. This is opened by choosing 'Manage Text Display' from the Junction menu or by clicking the button to the right of the Text Display Format drop down list.



The Text Display Format Manager lists the available Text Display Formats, allows them to be copied or new ones created and displays the layout of data and result items on Links and Link Connectors or Lanes for the Text Display Format being edited.

#### Creating a New Text Display Format

To create a new Text Display Format click the Add New button to the right of the 'Available Formats' list. A new Display Format initially called '(name)' will be created. This should be given a proper name by changing its name in the 'Name' box. The Text Display Format can then be defined as described below in 'Editing a Text Display Format'.

#### Copying an Existing Text Display Format

An existing Text Display Format can be copied by selecting it in the 'Available Text Display Formats' list and clicking 'Copy'. A new Text Display Format called 'copy of (copied Format Name)' will be created.

#### Deleting a Text Display Format

A Text Display Format can be deleted by selecting it in the 'Available Text Display Formats' list and clicking 'Delete'.

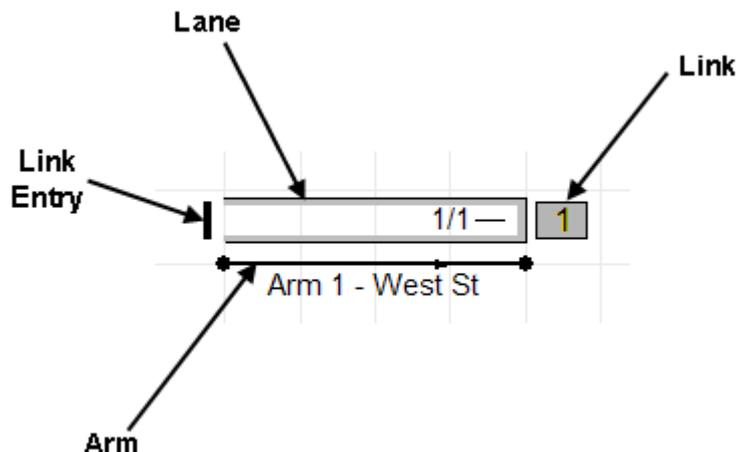
#### Editing a Text Display Format

A Text Display Format can be edited by selecting it in the 'Available Text Display Formats' list and using the drop down lists to set the desired data or results items for each position on Links and Link Connectors or Lanes.

Links and Lanes can display up to three data or result items: one at each end and one in the middle. Link Connectors can only show a single item in the middle of the Link Connector. Any position can be left blank if desired.

### 3.2.4. Working with Arms

An Arm in LinSig is a one-way section of road forming part of the LinSig Network. Arms take no part in modelling and are principally for grouping Links to allow them to be graphically manipulated as a single unit. Arms always contain at least one Lane and Link. The figure below shows a typical Arm just after it has been created and contains only a single Lane and Link which are not yet connected to anything else. The yellow/grey colour of the Link box indicates the Link is not signal controlled. Signal controlled Links are displayed using a bright yellow Link box.



#### 3.2.4.1. Creating New Arms

New Arms can be created in the Junction Layout View as follows:

- Choose 'Add Arm...' from the 'Arms' pop-out menu on the Junction menu. A new Arm will be created which can be dragged into its desired position and dropped by clicking with the mouse. If necessary the Arm can be rotated and repositioned more accurately after it has been created as described below in 'Moving and Repositioning Arms'.
- When the Arm is dropped the Edit Arm dialog box is displayed. This allows the Arm's settings to be entered.

The screenshot shows the 'Edit Arm' dialog box. It has a title bar with 'Edit Arm' and a close button. The dialog contains the following fields and controls:

- 'Arm No :' with a dropdown menu showing '1'.
- 'Group:' with an empty dropdown menu.
- 'Arm Name' with a text input field containing 'West St'.
- 'OK' and 'Cancel' buttons at the bottom.

- The following settings are available for an Arm:
  - **Arm Number.** The Arm Number will default to one more than the maximum Arm Number of the existing Arms. Arms can be numbered in any order but all Arm Numbers must be used with no gaps in the sequence. If the new Arm is allocated the same number as an existing

Arm the new Arm will be inserted into the Arm numbering sequence and higher numbered Arms renumbered.

- **Arm Name.** The Arm Name is a simple text name to describe the Arm.
  - **Arm Group.** The Arm Group the Arm belongs to (if any). The Arm Group is used to group Arms so that they can be moved as a group rather than one by one.
- Click OK to finish creating the Arm.

### 3.2.4.2. Moving and Repositioning Arms

Arms can be freely positioned using the mouse as follows:

- Select the Arm with the mouse. The Arm turns red indicating it is selected.
- Use the circular 'handles' at each end of the Arm to reposition the Arm. The direction of traffic on the Arm is indicated by the arrow on the Arm.
- If you have a number of Arms which you want to move together, for example all the Arms at a Junction, they can be grouped using an Arm Group and move as a group rather than one by one.

Tip: To assist with positioning graphical Items LinSig can display a grid and snap the cursor to the grid when dragging. The grid is controlled from the View menu. The grid size is controlled on the 'Graphical Settings' tab of the File Settings dialog box which is opened from the File Menu.

### 3.2.4.3. Editing Arm Settings

An Arm can be edited by selecting the Arm with the mouse and choosing 'Edit Arm' from the 'Arms' pop-out menu on the Junction Menu. This displays the Edit Arm dialog box which can be used to change the Arm's settings as described in 'Creating New Arms' above.

### 3.2.4.4. Deleting Arms

An Arm can be deleted by selecting the Arm and choosing 'Delete Arm' from 'Arms' pop-out menu on the Junction menu. It is important to remember that deleting an Arm also deletes any Links and Lanes belonging to the Arm. Undo is of course available in case of accidental deletion.

### 3.2.5. Working with Lanes and Links

LinSig uses Lanes and Links to define in detail how traffic moves through and queues on each Arm. The two items are used as follows:

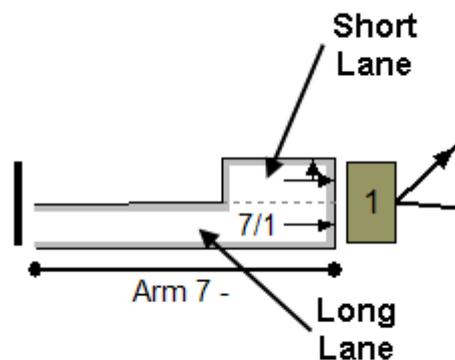
- Lanes define how much road space is available to traffic on the Arm by specifying how many Lanes exist on the Arm and whether they are full length Lanes or short Lanes.
- Links group Lanes together to define how different Lanes interact. For example short Lanes are dependent on their adjacent Long Lane and must be grouped together in a single Link.

More detail on the traffic modelling concepts underlying LinSig Lanes and Links is provided in the Modelling Section.

### 3.2.5.1. Working with Lanes

Lanes are added to each LinSig Arm to define the number of lanes available to traffic on an Arm and also the Length of each Lane. Lanes can be either:

- **An Infinitely Long Lane.** A Long Lane which extends back to a previous junction is regarded as infinitely long for modelling purposes as it is capable of providing a constant saturation flow over its whole green duration.
- **A Short Lane (Flare).** A Lane should be defined as a Short Lane if it is so short that it will discharge all its queued traffic in a typical green period. LinSig will calculate how long the Short Lane takes to empty, modelling a saturation flow contribution from the Lane to its Link only until the Lane empties. If a Short Lane is so long it is never likely to fully discharge during the longest likely green period it makes no difference to the results whether it is modelled as a Long Lane or a Short Lane.



#### Creating New Lanes on an Arm

Lanes can be created on an Arm in two ways:

- Create a new Lane on the Arm also creating a new Link attached to the Lane.
- Create a new Lane on the Arm attached to an existing Link.

Whichever way the Lane is created its attached Link can be changed at a later stage if necessary. For beginners it is suggested each Lane is created with a new Link, merging and combining Links as appropriate in a later step.

#### Creating a New Lane and Link

A new Lane together with a new Link can be created as follows:

- Select a Lane on the Arm adjacent to the desired position of the new Lane.
- Choose 'Add Lane to Left in new Link' or 'Add Lane to Right in new Link' as appropriate. A new Lane with a new Link will be inserted or added to the Arm.

#### Creating a new Lane attached to an existing Link

A new Lane can be created attached to an existing Link as follows:

- Select a Lane on the Arm adjacent to the desired position of the new Lane and attached to the same Link as the new Lane.
- Choose 'Add Lane to Left in same Link' or 'Add Lane to Right in same Link' as appropriate. A new Lane will be created attached to the same Link as the selected Lane.

## Creating a short Opposed Right Turn Lane – A special case

Short right turn lanes which contain only right turning traffic opposed by oncoming traffic are a special case. LinSig V2.4 and above provides a special Link model to model this common but previously difficult to model situation. As the short right turn Lane and its parameters are specified as part of this special Link model it is not necessary to create a Lane representing the short Lane. More details on using the new model is given below in the Links section.

## Editing Lanes

Each Lane contains a number of settings which control how the Lane is displayed and the Saturation Flow contribution it makes to its Link. A Lane is edited using the Lane Details dialog box which is opened by selecting a Lane (NOT its Link) and choosing 'Edit Lane' from the 'Lanes' pop-out menu on the Junction Menu.

Flowgroup	Expected Usage	Default
2006 Friday AM Peak	5.0	<input checked="" type="checkbox"/>
2006 PM Peak	5.0	<input checked="" type="checkbox"/>

To	Calculated Turn Prop.	Radius (m)
Arm 5 (Ahead)	100.0 %	Inf

## Setting the Lane Lengths

A Lane can be regarded as either:

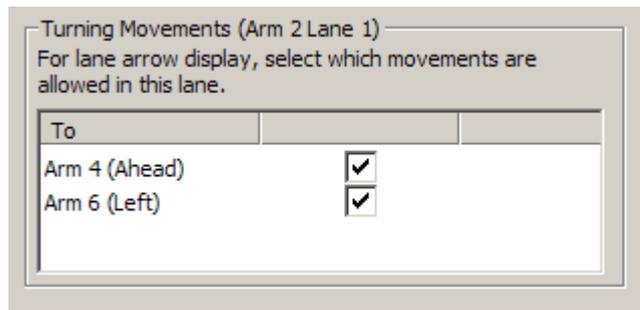
- A Long Lane if it extends back to the previous junction or is long enough that it will not empty during the longest expected green period. To make a Lane a Long Lane tick the 'Long Lane' box in the Lane Length section of the Edit Link dialog box.
- A Short Lane, or Flare, if it will empty during the green period leading to a reduction in Saturation Flow on the Link for the remainder of the green. To make a Lane a Short Lane un-tick the 'Infinitely Long Lane' box in the Lane Length section of the Lane Details dialog box and specify the Lane's length. Two Lane lengths can be defined. These are:
  - **The Physical Length of the Lane.** This is the maximum number of PCUs which could fit into the Lane if it were full. This is not used in modelling but allows the physical length to be recorded for future reference.
  - **The Expected Usage of the Lane.** This is the average number of PCUs in the Lane at the start of green. This will always be less than or equal to the physical length of the Lane due to traffic being prevented

from entering the short lane because of queuing traffic in an adjacent Lane. This effect is described in greater detail in the Modelling Background section. With LinSig V2.4 and above a different Expected Usage can be specified for each Flow Group. A default Expected Usage is entered in the 'Default Expected Usage' box. This value applies to all Flow Groups with no custom value defined. A custom value can be specified for any Flow Group by unticking the 'Default' box for the Flow Group, clicking on the Expected Usage and changing the value.

### **Configuring Lane Turning Movements**

Each Lane displayed in the Junction Layout View can show turn arrows specific to itself. The turn arrows shown on a Lane are mainly for graphical purposes as the Link governs the modelled turning movements possible and each Lane is actually modelled as though all turning movements for the Link could take place. The purpose of the Lane's turn arrows is to record the actual turning movements allowed in the Lane. This assists other users assessing the assumptions in the model and its accuracy. The Turning Movements definitions are also used in calculating Geometric Saturation Flows as described below.

The 'Turning Movements' section in the Edit Lane dialog box lists the turning movements possible on the Lane's parent Link. The turn arrows displayed for the Lane can be configured by selecting one or more turning movements from the 'Turning Movements' box.



If any Turning Movements are shown in red these relate to importing a LinSig V1 file. This is covered in more detail in 'Importing a LinSig V1 file' in Section 3 above.

### **Specifying Lane Saturation Flows**

Lane Saturation Flows can be specified manually or can be calculated from a Lane's geometry using the formulae published in the TRRL report RR67. Saturation flows are always specified in Passenger Car Units (PCU) in LinSig.

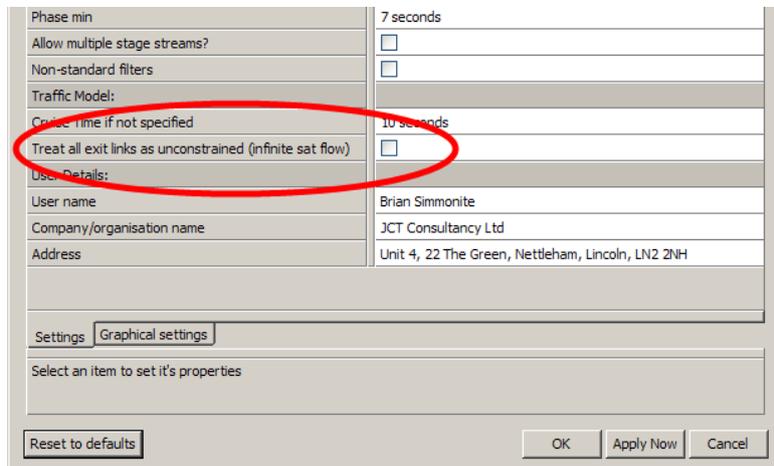
Although using saturation flows calculated from Geometry may seem like an easy option, it is recommended that wherever possible at least a brief saturation flow survey is done for an existing junction. The RR67 formula, although a good starting point, does not allow for all significant factors when estimating saturation flow. For example, no allowance is made for regional variations in saturation flow leading to the same estimate for Central London and rural Lincolnshire. Additionally the data underlying RR67 was collected over 20 years ago and traffic conditions may well have changed significantly in the mean time. Before using saturation flows calculated from geometry in LinSig it is advisable to obtain and read RR67 and satisfy yourself that the methodology used is acceptably accurate.

It is good practice to consult the Traffic Signals Department for a junction's location as most will have considerable local knowledge as what constitutes an acceptable estimate of saturation flow for similar junctions in the area.

### **Specifying Unconstrained Exit Links**

An Exit Link in LinSig is any Link which has no Link Connectors leaving the Link. Exit Links in LinSig are used purely to define where traffic exits the Network and generally should not

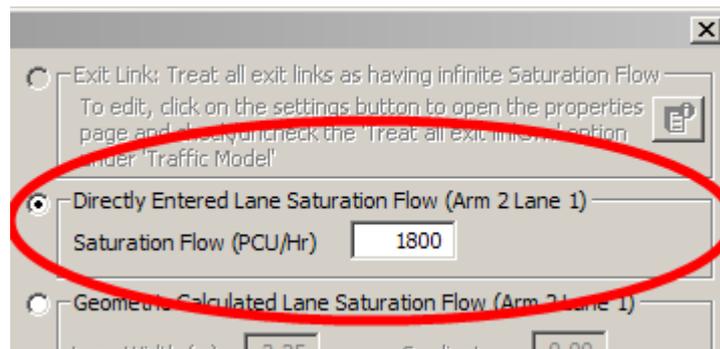
be used for modelling. If it is desired to model the capacity on an Exit Arm it is usually better practice to extend the model to include the next downstream junction. If an Exit Link is left with a default saturation flow this can sometimes cause minor but distracting modelling errors particularly if the wrong number of Lanes or too low a saturation flow is used. To remove the potential for Exit Link issues LinSig can be set to model all Exit Links as unconstrained with infinite capacity. This is a global setting for all Exit Links and cannot be set independently for each Link.



To enable this setting choose 'Settings for this file' from the LinSig File menu and tick 'Treat all Links as Unconstrained (infinite sat flow)' in the Traffic Model section of the settings list. All existing and newly created Exit Links in the current file will be automatically treated as unconstrained for modelling purposes. To choose this setting in all future LinSig models choose the same setting in the 'Defaults for new Files' dialog box again opened from the File menu.

### **Specifying Lane Saturation Flows Manually**

Lane Saturation Flows are entered manually by selecting 'Directly Entered Lane Saturation Flow' in the Edit Lane dialog box and entering a saturation flow rate in PCU/Hr. Saturation Flows can also be edited using the Lane Grid Data View which is often faster to use when changing a number of saturation flows.



### Calculating Lane Saturation Flows from Lane Geometry

As discussed above LinSig uses an extended version of the formulae from TRRL report RR67 to calculate saturation flows from Lane Geometry. Geometric parameters for the Lane and for each turning movement out of the Lane are required.

To	Calculated Turn Prop.	Radius (m)
Arm 4 (Ahead)	33.3 %	Inf
Arm 6 (Left)	66.7 %	10.00

The Lane based geometric parameters are:

- **Lane Width(m).** The Lane width.
- **Gradient(%).** The Lane's gradient. Only uphill gradients have an effect on the saturation flow. Downhill gradients do not adjust the saturation flow upwards.
- **Treat as Nearside Lane.** This setting reduces the saturation flow by 140 PCU/hr due to the 'frictional effect' of potential hazards (such as gutters or pedestrians stepping out) in the near side Lane. There is debate on whether this setting should be used for the right most lane of a multi-laned stop line where it could be argued there is also a frictional effect on traffic. RR67 gives some guidance on this but if in doubt it is conservative to apply the reduction by setting the Lane as a near-side lane.

LinSig allows turning parameters to be defined for each Lane Turning Movement as specified in 'Turning Movements' above.

The Turn based geometric parameters are:

- **Turning Proportion(%).** Where only a proportion of the total vehicles using the Lane are using a Turn LinSig combines the saturation flows for traffic on each Turn to produce a combined saturation flow for the Lane. As the turning proportion varies according to the Traffic Flow Group used in LinSig, LinSig will automatically estimate the turning proportion for each Lane from the current Traffic Flow Group.
- **Turning Radius(m).** The minimum radius of curvature of a turning vehicles path. This should be measured very carefully for a left turn as the often small radius can have a large effect on the estimated saturation flow.

If any Turning Movements are shown in red these relate to importing a LinSig V1 file. This is covered in more detail in 'Importing a LinSig V1 file' in Section 3 above.

For more detail on the above methodology and parameters see the RR67 report. This can be obtained from TRL Limited.

## Deleting Lanes

A Lane can be deleted by selecting the Lane and choosing 'Delete Lane' from the 'Lanes' pop-out menu on the Junction Menu. If the Lane is a Link's only Lane the Link will also be deleted along with any items dependent on the Link such as Routes and Link Connectors.

### 3.2.5.2. Working with Links

Links in LinSig represent independent streams of traffic passing through an Arm. Each Link represents one or more lanes of traffic which can either be long (extending back to the previous junction) or short (flared) lanes. A Link controlled by a Signal Phase is shown as a yellow box in front of its Lanes(s). An unsignalled Link not connected to a Phase is shown as a grey box.

Getting the Link Structure right is possibly the most important aspect of accurately modelling a junction in LinSig. It is deliberate that you (the engineer) are required to manually structure Links on an Arm. A far better model of the junction behaviour can be obtained by an engineer with knowledge of the junction using experience, than a computer applying rigid rules of how lanes ought to interact in an ideal situation.

#### Link Golden Rules

When designing Link Structures the following 'golden rules' for Links should be remembered. These rules are designed to obtain a balance between allowing the LinSig traffic model to be relatively easy to use whilst still being general enough to model most junctions accurately.

1. Each Link is completely independent from other Links and traffic behaviour on one Link does not affect the traffic behaviour on another Link. (Opposed Links are an exception to this as they are obviously affected by their Opposing Links)
2. All Lanes allocated to a Link must receive the same green signals. i.e. All lanes must be controlled by the same Phase(s).
3. Traffic is assumed to distribute equally between all Lanes on a Link.
4. Queuing is assumed to be identical in each lane allocated to a Link.
5. A Link must always contain at least one infinitely long Lane.
6. Opposed Links must always contain a single infinitely long main lane. Right turning traffic waiting in the middle of the junction partially blocking ahead traffic is catered for, as is traffic waiting behind the stop line in a short right turn bay in V2.4 and above. Opposed short lanes are termed 'right turn bays' and are represented as part of the Opposed Link rather than being added as a separate short lane.

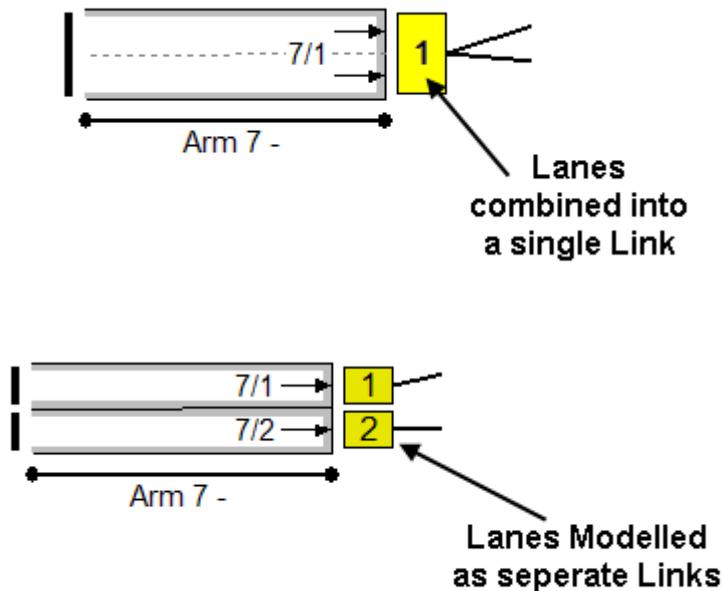
Sometimes it is not possible to satisfy all of the above rules at once, in which case the Link structure should be designed to satisfy the rules which have the greatest impact on capacity.

More information and examples of how to design Link structures to model different scenarios in LinSig, are included in the 'Modelling Background' section.

#### Lane Arrangement and Saturation Flow Profiles

Each LinSig Link can contain one or more Lanes. The Lane structure of a Link is used purely to define a Saturation Flow Profile for the Link which will be used in the traffic model. Each Lane has a Saturation Flow defined, which are summed to calculate the Link's total Saturation Flow. Adding Short Lanes to a Link means that the Lane only contributes to the Saturation Flow Profile until it empties leading to a stepped Saturation Flow Profile.

Where the Link 'golden rules' introduced above are satisfied by two or more adjacent traffic lanes they can be grouped together into a single Link. Alternatively each long traffic lane could be modelled as a separate Link.



The benefits of grouping lanes together are:

- There are fewer Links to enter.
- The model is smaller and is generally easier to follow.
- There are fewer routes making manual assignment of traffic to routes quicker.
- There are fewer Links in reports leading to more concise reports.
- Traffic (possibly on a number of turning movements) is split evenly between lanes on the Link with no further effort. When a separate Link is used for each lane you must distribute traffic between routes to achieve a realistic sharing of traffic between Links. LinSig assists with the allocation of traffic to Routes by providing a basic automatic assignment tool but manual adjustment is sometimes required to refine the flow allocation.

The disadvantages of grouping lanes together are:

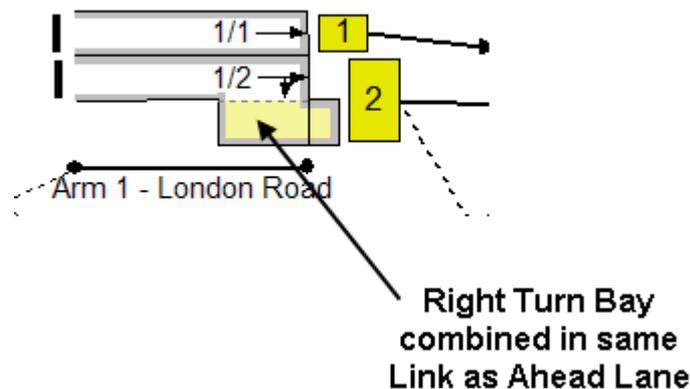
- It sometimes needs careful thought as to whether lanes can be grouped together without reducing model accuracy by grouping lanes with dissimilar queuing.
- Having more Links provides greater flexibility by allowing traffic to be assigned to routes with more control. For example, different traffic flow pattern in different Flow Groups may require different Link structures. A left and ahead lane may become a de-facto left only lane as the left turn flow increases.
- If the model is extended to include an upstream or downstream junction the assumption of equal traffic flows in each lane may be incorrect due to traffic choosing lanes to be ready for a downstream junction.
- The accuracy of each lanes flow profile may be reduced as grouping lanes together can lead to a cruder representation of the Network.

Whether to group Lanes together into Links is a decision which is partly governed by the needs of each individual model and partly personal choice. Some users will prefer to use more Links to give greater flexibility accepting the extra work involved. Others will prefer to

use less Links saving time in the process but accepting it may limit the model and reworking of the model may be required if traffic flows change.

Two special cases include:

- Short lanes or flares must always be grouped with an adjacent long lane in order to feed traffic into the short lane.
- Where a short lane is provided for opposed right turning traffic this should be defined as a right turn bay associated with its adjacent long lane. The unopposed long lane and its adjacent opposed short lane are modelled as a single Link the Link is defined as a give-way Link and the right turn bay is then specified as part of the Link's give way parameters.



### Creating New Links

New Links can be created in two ways. These are:

- Creating a new Lane with a new Link. This creates a new Link attached to the new Lane.
- Splitting an existing multi-Lane Link into two Links.

#### **Creating a New Lane and Link**

A new Link containing a new Lane can be created as follows:

- Select a Lane on the Arm adjacent to the desired position of the new Lane/Link.
- Choose 'Add Lane to Left in new Link' or 'Add Lane to Right in new Link' as appropriate. A new Lane with a new Link will be inserted or added to the Arm.
- The new Link is created with default settings. It is not connected to any other Links yet and therefore does not display any directional arrows. The Link has no traffic flow until Routes through the Link are created and traffic flow allocated to these Routes.

#### **Splitting an Existing Link into two Links**

An existing multi-Lane Link can be split into two Links as follows:

- Select one of the Link's Lanes adjacent to the desired split point.
- Choose 'Split Lane' from the 'Lanes' pop-out menu on the Junction Menu and choose 'Split Lanes to Right into Separate Link' or 'Split Lanes to Left into Separate Link' as appropriate.
- A new Link will be created containing some of the old Link's existing Lanes whilst the old Link will be left with the remainder of its Lanes.

- Renumber Links if necessary to achieve a sensible numbering sequence.
- Create any new Link Connectors needed on the new Link and reassess Routes to allocate an appropriate amount of traffic to the new Link.

### **Selecting Links**

A Link is selected by clicking the yellow/grey box representing the Link with the mouse. The Link is highlighted in red indicating it is selected. The Link will also be highlighted in any other open View displaying Links such as the Link Results View.

### **Editing Links**

A Link has a many different settings which can be edited using the Edit Link dialog box. The Edit Link dialog box can be opened for a Link either by selecting the Link and choosing 'Edit Link' from the 'Links' pop-out menu on the Junction menu, or by double clicking on the Link.

A detailed explanation of Link Settings is given below in 'Configuring Link Settings'.

### **Deleting Links**

A Link can be deleted by selecting it with the mouse and choosing 'Delete Link' from the 'Links' pop-out menu on the Junction menu, or by deleting the Links only Lane.

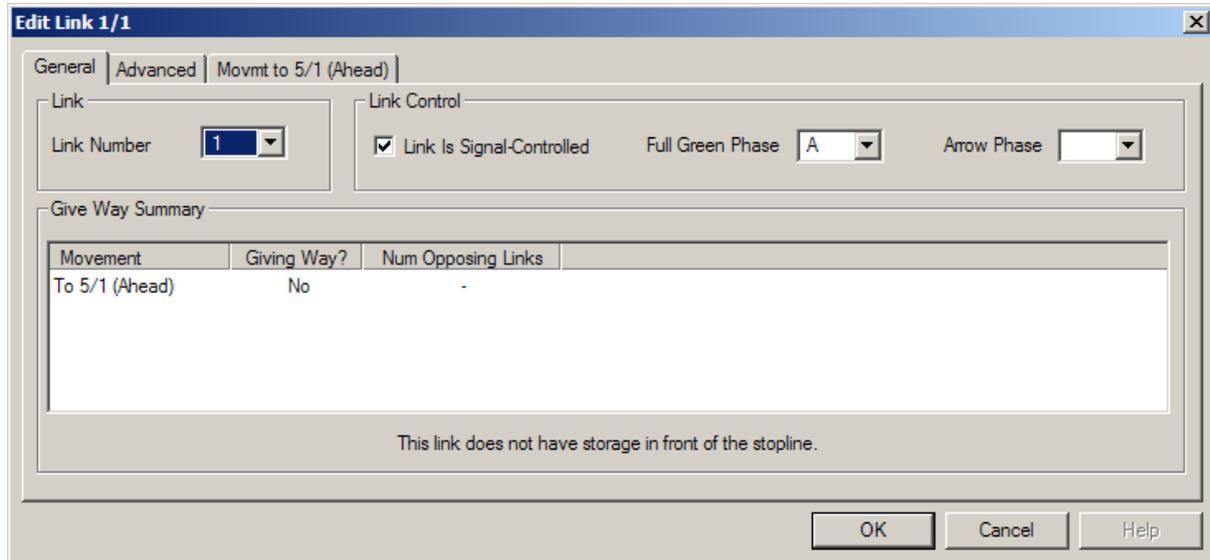
Deleting a Link also deletes the following:

- Any Lanes contained by the Link.
- Any Link connectors entering or leaving the Link.
- Any Routes passing through the Link.
- Any graphs or other graphical items associated with the Link.

Any traffic flow allocated to Routes which are deleted will be de-allocated and the Actual Flows Matrix in the Traffic Flows View will show a flow deficit reflecting this. The flow on Routes through the deleted Link should be reallocated either to Routes through other Links or to Routes through any new Links replacing the deleted Link. This can be done either manually using the Route List in the Traffic Flows View or by reallocating all flows to Routes by choosing 'Allocate OD Flows to Routes' from the Routes menu. More information is given in the section on the Traffic Flows View.

### 3.2.5.3. Configuring Link Settings

Link settings are configured using the Edit Link dialog box. This is opened for a Link by selecting the Links yellow/grey box and choosing 'Edit Link...' from the 'Links' pop-out menu on the Junction menu, or by double-clicking the Link. It is advisable to specify Link turning movements using Link Connectors before editing Links or some options such as specifying give way opposing movements may not be available. These settings can of course always be returned to later after Link Connectors have been added.



The Edit Link dialog box contains a number of tabs. These are:

- **General.** This tab contains basic settings which apply to all Links.
- **Advanced.** This tab is always available and includes a number of advanced settings which may not always need changing.
- **Movement Tabs.** A separate tab is provided for each turning movement leaving the Link. Each tab allows settings relating to that turning movement to be set.
- **Storage in Front of Stop Line.** This tab is only available if the Link is signal controlled and one or more movements on the Link gives-way to other Links. The tab includes settings relating to various bonus capacity effects applicable only to right turns at signals.
- **Non-Blocking Storage.** This tab is only available when the Link contains a mixture of give-way and non give-way movements. It is principally used for situations where an opposed right turn movement may block a non-give-way movement (usually ahead).

## General Settings

The screenshot shows the 'Edit Link 1/1' dialog box with the 'General' tab selected. The 'Link' section has 'Link Number' set to 1. The 'Link Control' section has 'Link Is Signal-Controlled' checked, 'Full Green Phase' set to 'A', and 'Arrow Phase' set to an empty dropdown. The 'Give Way Summary' section contains a table with the following data:

Movement	Giving Way?	Num Opposing Links
To 5/1 (Ahead)	No	-

Below the table, it states: 'This link does not have storage in front of the stopline.' At the bottom right, there are 'OK', 'Cancel', and 'Help' buttons.

The General tab contains the following settings:

- **Link Number.** The Link Number is the main way of identifying Links. Links are numbered separately for each Arm so it is usually best to refer to a Link as a combination of its Arm and Link, for example Link 1/2 refers to Link 2 on Arm 1. Links do not have to be numbered in any order but it is good practice to number them in order from the nearside to the offside.
- **Link is Signalled Controlled.** Ticking the 'Link is Signal Controlled' box specifies the Link as a signal controlled Link and allows the Controlling Phases to be specified.
- **Full Green Phase.** The Full Green Phase is the main three-aspect phase which controls the Link. All Links which are controlled by signals must have a Full Green Phase defined.
- **Arrow Phase.** The Arrow Phase applies only to Links which are controlled by a filter or Indicative green arrow (IGA) as well as a main three-aspect phase. The Arrow Phase can only be entered if a Full Green Phase is specified and the Full Green Phase is the associated Phase of a Filter or IGA Phase. The LinSig traffic cycle model will take into account which Phase is controlling the Link at each point in the cycle.
- **Give Way Summary.** The Give-Way Summary lists the different turning movements exiting the Link and summarises which movements give way to other Links. Further give-way details are contained on each movement's individual tab in the Edit Link dialog box.

## Advanced Settings

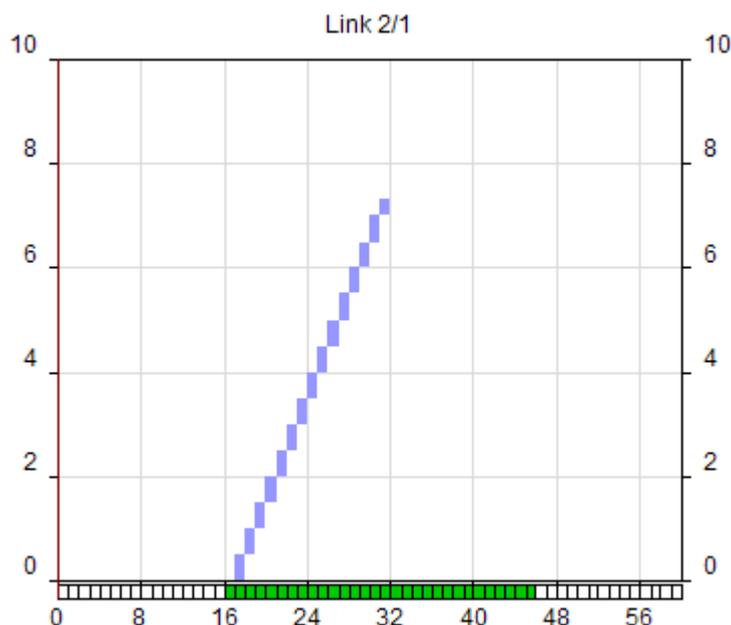
The screenshot shows the 'Edit Link 1/1' dialog box with the 'Advanced' tab selected. The 'Effective Green Displacements' section has 'Start Disp. (s)' at 2 and 'End Disp. (s)' at 3. The 'Random Delay' section has the 'Ignore Random Delay' checkbox unchecked. The 'Queue de-silver' section has an empty 'De-silver threshold (pcu)' field. The 'Optimiser Queue Constraints' section has an empty 'Excess Queue Limit (pcu)' field, 'Degree of Saturation Weighting per Excess PCU (%)' at 0.00, and 'Delay Weighting per Excess PCU (pcuHr)' at 0.00. The 'OK', 'Cancel', and 'Help' buttons are at the bottom right.

The Advanced tab contained the following settings:

- **Start Displacement.** The Start Displacement specifies how long it takes traffic on the Link to achieve Saturation Flow when the Link receives a green signal. LinSig assumes discharge across the Links stop line is zero for the duration of the Start Displacement before jumping to Saturation Flow after the Start Displacement has expired. The green duration adjusted for the Start and End Displacements is called the Effective Green. In the UK the Start Displacement is commonly set to 2 seconds although where justified by site or regional data, this value can be changed. Outside the UK where Red-Ambers are not used the Start Displacement can be changed to adjust for any difference in effective green.
- **End Displacement.** The End Displacement is similar to the Start Displacement but applies to the end of the green period. It specifies how long Saturation Flow is maintained for after the Link's green has ended. In the UK the End Displacement is commonly set to 3 seconds although where justified by site or regional data, this value can be changed.
- **Optimiser Queue Constraints.** The Optimiser Queue Constraints can be used to help with modelling queue blocking back from one Link to an upstream Link. No input is required if excess queuing is not occurring. The constraints allow the LinSig Stage length optimiser to be discouraged from producing stage lengths which lead to queues on Links exceeding the Link length. For example if a Link between two junctions was a single lane of 100m this provides space for approximately  $100/6 = 16$  PCU. Because the vertical queuing model used in LinSig (more details are in the Modelling Background Section) does not model blocking back from Links so depending on the other Link data LinSig may model a queue of 20PCU which obviously extends beyond the end of the Link. Setting a queue optimiser constraint of 16 PCU encourages the optimiser to choose a longer green time reducing the queue on the Link to below 16 PCU. The individual parameters are:
  - **Excess Queue Limit (PCU).** The queue length beyond which LinSig will try to reduce the queue. This is normally set equal to the queuing space on the Link but can also be set to less than the queuing space to force the optimiser to be more aggressive in reducing the queue.
  - **Degree of Saturation Weighting (%).** This value is only used when optimising for Practical Reserve Capacity (PRC). LinSig will increase the degree of saturation of the Link as seen by the optimiser when a

Links queue exceeds the Excess Queue Limit on the Link. When this occurs LinSig biases the optimiser to attempt to reduce the real degree of saturation on the Link more than it otherwise would. This has the effect of reducing the queue on the Link. LinSig increases the degree of saturation by the Degree of Saturation Weighting multiplied by the average queuing exceeding the Excess Queue Limit. A higher value will cause the optimiser to be more aggressive in reducing the queue. Too high a value however may prevent the optimiser from finding optimal signal settings. It is recommended to experiment with different values for each model.

- **Delay Weighting (pcuHr).** The delay weighting serves the same purpose as the Degree of Saturation Weighting but is used when optimising for minimum delay. Again a higher value will cause the optimiser to reduce queues more aggressively.
- **Random Delay.** On some Links the assumptions used on the level of Random Delay used by LinSig may be unrealistic for the particular conditions on the Link. The most common example is a signal roundabout circulatory Link. As the Links feeding circulatory Links are often only a short length traffic platoons are often very regular and non-random leading to an overestimation of Random Delay at higher degrees of saturation. Ticking the 'Ignore Random Delay' box omits Random delay from the Link which may lead to a more realistic estimation of queuing and delays. Please note it is down to you as the engineer to make the judgement on whether a Link has sufficiently non-random characteristics to make it justifiable to ignore Random Delay. If in doubt it is more conservative to leave the box unticked.
- **Queue De-Sliver Threshold (PCU).** A Sliver Queue is defined as a queue which contains a very small amount of traffic but whose back of queue extends a long way back from the stop line.



Sliver queues are a side effect of the type of traffic model used in LinSig and often occur when the traffic flow feeding a Link is similar to the Link's Saturation flow. During the green period nearly as much traffic is adding to the back of the queue as is leaving the front leading to a slowly decreasing number of PCU in the queue but a

rapidly extending back of queue. Where this is particularly severe, as is for example common at signal roundabout circulatory stop lines, the sliver queue may lead to reporting of unrealistically long mean-max queues and over severe application of Optimiser Queue Constraints.

The de-sliver mechanism detects a sliver queue which is unrealistic and prevents unrealistic back of queue values being reported. Exactly what is regarded as unrealistic is governed by the De-Sliver Threshold. The value of the De-Sliver Threshold is used by LinSig to decide when the number of PCU in the queue is unrealistically small. For example if the De-Sliver Threshold is set to 0.5 PCU LinSig will regard a potential sliver queue containing less than 0.5 PCU as unrealistic and allow traffic to exit the Link without adding to the queue. The exact value for the De-Sliver Threshold is best determined by experimenting with its value whilst observing the Link's Uniform Queue Graph and selecting a value which produces an intuitively sensible queue profile. If the value is set too low a sliver queue may form giving unrealistically high mean-max queues. If the value is set too high the real mean-max queue may be smoothed too much leading to an unrealistically high value of mean-max queue.

The De-Sliver mechanism is intended to allow obviously unintuitive unrealistically long queues to be corrected but the decision whether the queue profile is unrealistic rests (as it should do) with the engineer and care should be taken not to use the De-Sliver Mechanism to unjustifiably 'fiddle' queue lengths.

### LinSig Give Way Model

Several of the tabs in the Edit Link Dialog refer to the LinSig Give Way model. The Give Way Model is summarised here and further information is available in the Modelling Background Section.

In LinSig V1 gap acceptance on give-way Links was modelled using Tanners formula with gap acceptance parameters as suggested by Webster & Cobbe. Although this was widely accepted and a common standard it did not allow adjustments to be made for Links with atypical capacities and did not allow non-right turn Give-Way Links to be modelled.

For right turn Links the give-way model is only one component of the LinSig right turn model. The right turn model is described in more detail in the modelling section.

In LinSig V2 a new give-way model has been introduced. The model is used to predict the give-way capacity of a Link at each modelled time step based on the flow in that time step on any number of opposing Links.

In each model time step LinSig calculates the capacity of a Give-Way Link using the formula:

$$F = F_0 - A_1*Q_1 - A_2*Q_2 - \dots - A_n*Q_n$$

Where:

- **F** is the give-way capacity of the Link in a time step.
- **F<sub>0</sub>** is the maximum flow when the Link is potentially opposed but no opposing traffic is present.
- **Q<sub>1</sub>** is the flow in the current time slice on the first opposing link.
- **A<sub>1</sub>** is a coefficient for the first opposing Link which specifies by how much the capacity is reduced by flow on the first opposing Link.
- **Q<sub>2</sub>** is the flow in the current time slice on the second opposing link.
- **A<sub>2</sub>** is a coefficient for the second opposing Link which specifies by how much the capacity is reduced by flow on the second opposing Link.

- $Q_n$  is the flow in the current time slice on the second opposing link.
- $A_n$  is a coefficient for the second opposing Link which specifies by how much the capacity is reduced by flow on the second opposing Link.

### Movement Settings

The Movement tabs contain settings relating to an individual movement leaving the Link, for example a left turn or ahead movement. The Edit Link Dialog Box will contain a separate Movement tab for each movement.

**Edit Link 1/1**

General | Advanced | Movmt to 5/1 (Ahead)

Movement Give Way Data

This movement gives way

Maximum Flow while Giving Way (pcu/Hr) 1400

Saturation Flow when opposing traffic is stopped

Use Maximum Flow when Giving Way Value

Use Link Saturation Flow Value

Use Custom Value (pcu/Hr)

Opposing Links

#	Link	Coefficient	Conflict	Movements
+				
-				

OK Cancel Help

### Non-Give-Way Link

**Edit Link 1/2**

General | Advanced | Movmt to 6/1 (Right) | Storage In Front of S/L

Movement Give Way Data

This movement gives way

Maximum Flow while Giving Way (pcu/Hr) 1400

Saturation Flow when opposing traffic is stopped

Use Maximum Flow when Giving Way Value

Use Link Saturation Flow Value

Use Custom Value (pcu/Hr)

Opposing Links

#	Link	Coefficient	Clr Conflict	Movements	Movement 1	Movement 2
0	2/1	1.10	0	<input checked="" type="checkbox"/> All opposing?	<input type="checkbox"/> To 4/1 (Ahead)	<input type="checkbox"/> To 6/1 (Left)
1	2/2	1.10	0	<input checked="" type="checkbox"/> All opposing?	<input type="checkbox"/> To 4/1 (Ahead)	
+						
-						

OK Cancel Help

### Give-Way Link

The settings available on each Movement tab are:

- **This Movement Gives Way.** The 'This Movement Gives Way' tick box specifies whether the movement gives way to any other movements from other Links or whether it is simply controlled by signals or even free flowing. If the movement gives way the box should be ticked and data entered for the rest of the fields on the tab. If the movement does not give way the box can be left unticked and no further data entry is required on this tab.

- **Maximum Flow When Giving Way (PCU/Hr).** This is the maximum capacity of the Give-Way Link when it is giving way and therefore potentially opposed but no opposing traffic is present.
- **Saturation Flow when Opposing Traffic is Stopped (PCU/Hr).** This is the Saturation Flow for the opposed movement when the opposing traffic is stopped. When it is clear to opposed traffic that the opposed movement is stopped, for example when a right turns indicative arrow is running, the Link may have a higher Saturation Flow than the Maximum Flow value as traffic may not need to check for opposing traffic which is self evidently stopped. Often this value is the same as the Link's main saturation flow but may be different, for example if the opposed movement turns through a tight radius the saturation flow would be lower. The options available are:
  - **Use Maximum Flow when Giving Way.** Use the same value specified above in 'Maximum Flow When Giving Way'. This option should be used where it is felt that the Saturation Flow would not be different from the Maximum Flow value. Give Way Left Turns often require this option as the angle of turn often means it is not obviously apparent to opposed traffic that the opposing movements are stopped.
  - **Use Link Saturation Flow.** The Links Saturation Flow specified on its Lanes is used when the opposing Links are stopped.
  - **Use Custom Value (PCU/Hr).** A custom value can be specified if for any reason a value other than the other two options is required.
- **Opposing Links.** In LinSig V2.4 and above any number of opposing Links can be used to oppose a movement. Also each movement can have different opposing Links. Opposing Links can be added to the Movement Tab by clicking the '+' button to the left of the Opposing Links List. Settings for each Opposing Link can then be changed by clicking the setting to be changed in the List. The Settings are:
  - **Link.** The Link Number of the Opposing Link.
  - **Coefficient.** The  $A_n$  value as described above in 'LinSig Give Way Model'. This is used to specify by how much the traffic flow on the Opposing Link reduces the Give Way Link's capacity.
  - **Clear Conflict Time(sec).** The Clear Conflict Time is the time between a vehicle crossing the opposing Link's stop line and the time it ceases to oppose traffic on the Give Way Link. It is typically used on large junctions to allow for the fact that traffic on the opposing Link will take a few seconds to clear before a Give Way Link can start to discharge. Its value will depend on the size of the junction and should be measured on site where possible. The Clear Conflict Time is often ignored in some models (including LinSig V1) and may be a cause of differences between model results. The Clear Conflict Time can be specified separately for each opposing Link.
  - **Opposing Movements.** Each Opposing Link may itself have a number of Movements each of which may or may not oppose the Give Way Link. The Opposing Movements column allows which movements leaving the Opposing Link actually oppose to be defined. If all movements oppose the 'All Opposing' box can be left ticked. If one or more movements do not oppose the 'All Opposing' box can be unticked and the boxes next to each individual opposing movement ticked or unticked as appropriate.

## Storage in Front of Stop Line Settings

Edit Link 1/2

General | Advanced | Movmt to 6/1 (Right) | Storage In Front of S/L

This is a signal-controlled Right Turn giving way to oncoming traffic.

Does the link have Right-Turn Storage in front of the stopline ?

Right Turn Storage in Front Of Stopline (PCU)  Right Turn Move Up (s)   Auto-Calc Using Storage

Right Turn Factor  Max Right Turns In Intergreen (PCU)

OK Cancel Help

Links which include Right Turns that have Storage in front of the Stop Line require additional settings to model all the components of right turn capacity modelled by LinSig. These settings are contained on the 'Storage in Front of Stop Line' tab. They include:

- **Does the Link have Right Turn Storage in Front of Stop Line?** This setting specifies whether the Link contains Storage in front of the Stop Line and hence whether the remaining settings on the tab are required to be validly completed.
- **Right Turn Storage in Front of Stop Line.** This is the total number of PCUs which can store in front of the Stop Line whilst waiting to turn right. LinSig uses this value in calculating right turn capacity bonuses for traffic discharging with an indicative green arrow.
- **Right Turn Factor.** The Right Turn Factor controls the amount of bonus capacity due to right turning traffic storing in front of the stop line. The default value is 0.5 and it is generally appropriate to retain this value unless site data suggests a different value. The Right Turn Factor is explained in more detail in the Modelling section.
- **Right Turn Move-Up Time(sec).** This specifies the time for a vehicle at the stop line to reach the point at the front of the storage area in the centre of the junction where it waits for a gap to turn right. LinSig can estimate this value by assuming the move-up time is one second for every one PCU of storage in front of the stop line.
- **Maximum Right Turns in Intergreen(PCU).** This setting specifies how many PCUs waiting in front of the stop line can turn right during the Intergreen after a right turn Link has terminated. It may be different from the Right Turn Storage value as it may not be possible for all vehicles in front of the stop line to turn right during the Intergreen.

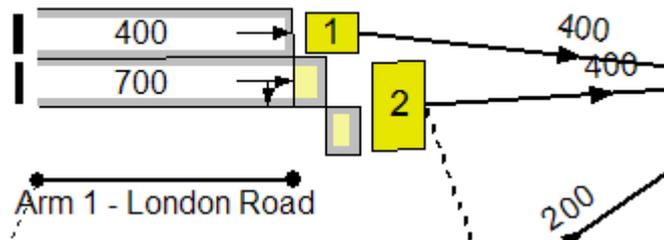
### Non-Blocking Storage

The Non-Blocking tab is only available when the Link contains a mixture of give-way and non give-way movements. It is principally used for situations where an opposed right turn movement may block a non-give-way movement (usually ahead). The only setting on this tab is:

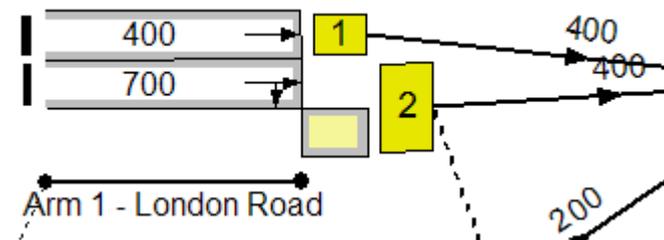
- **Total Number of PCUs on Give-Way Movements that can store without blocking Non-Giving-Way Movements.** This value is the number of PCUs on the give-way movement (usually the right turn) which can queue before blocking the non-

giving way movement (usually the ahead or ahead/left movement). Three cases can occur. These are:

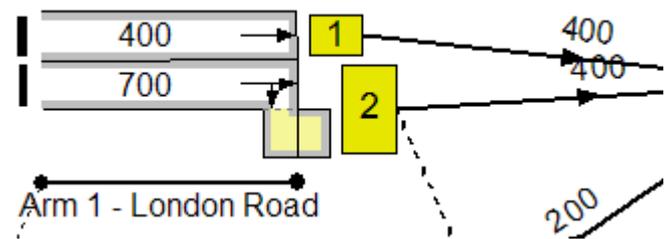
- **The Non-Blocking Storage is less than the Total Storage in front of Stop Line.** LinSig will use the whole of the Right Turn Storage in calculating bonus capacities but will model the Ahead traffic as blocked as soon as the Non-Blocking Storage is full.



- **The Non-Blocking Storage is equal to the Total Storage in front of Stop Line.** LinSig will use the whole of the Right Turn Storage in calculating bonus capacities and will model the Ahead traffic as blocked when the Storage is full. This is modelled the same as above but the Total Storage and Non-Blocking Storage is coincidentally the same.

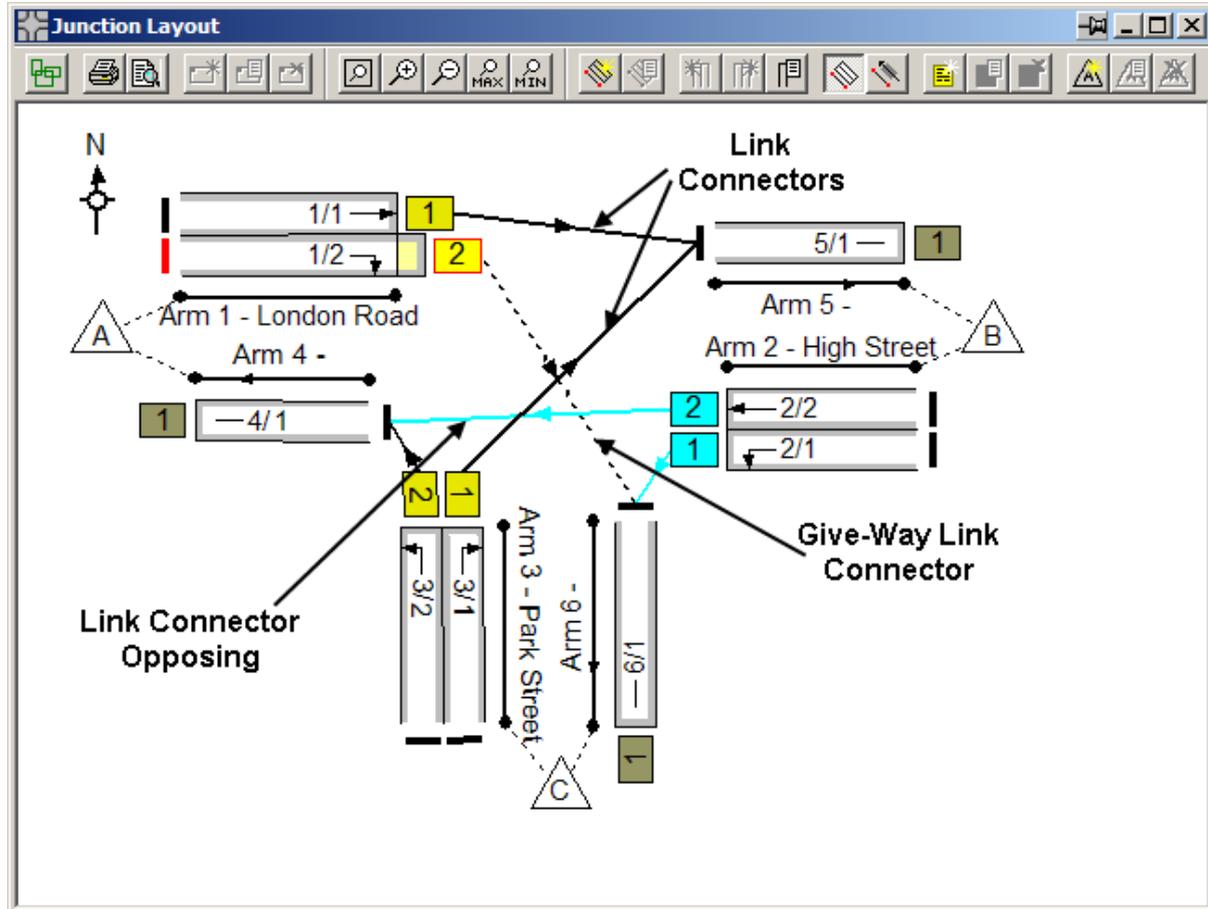


- **The Non-Blocking Storage is greater than the Total Storage in front of Stop Line (Right Turn Bay).** LinSig will use the whole of the Total Right Turn Storage in calculating bonus capacities but will only model the Ahead traffic as blocked when the queue in the Storage Area extends back beyond the stop line and fills the Right Turn Bay.



### 3.2.6. Joining Links with Link Connectors

Link Connectors are used in LinSig to define the traffic movements which can take place between Links. Link Connectors also specify the travel time between stop lines and the amount of platoon dispersion present on a movement. This allows different values for travel time and platoon dispersion to be used for each movement.



The diagram above shows Link Connectors joining Links to other Links. Link Connectors representing traffic movements which give way to other Links are shown dashed. If a give-way Link or give-way Link Connector is selected with the mouse its opposing Links are shown highlighted.

#### 3.2.6.1. Creating Link Connectors

Link Connectors can either be created between two existing Links or can be created between an existing Link and a new Link on a new Arm created at the same time as the new Link Connector. The facility to create new Arms on the fly allows Networks to be built more speedily.

To create a Link connector between two existing Arms:

- Select the Link Connector's starting Link.
- Drag the starting Link with the mouse. A Link connector and new downstream Arm and Link will 'tear off' of the starting Link.
- Drag the mouse pointer over the Link where the Link Connector will end. The 'tear off' Arm will disappear indicating no new Arm will be created.

- Drop the Link Connector on the downstream Link by releasing the mouse. A new Link Connector will be created between the two Links.

The ability to create a new Arm and Link simultaneously with a Link Connector is intended to speed the creation of Exit Arms. The feature can however be used to create any Arm. To create a Link Connector with a new Arm and Link:

- Select the Link Connectors starting Link.
- Drag the starting Link with the mouse. A Link connector and new downstream Arm and Link will 'tear off' of the starting Link.
- Drop the 'tear off' Arm and Link anywhere other than on an existing Link. A new Arm containing a single Link will be created with a Link Connector joining it to the starting Link.
- Edit the new Arm and Link as appropriate.

### 3.2.6.2. Editing Link Connectors

Link Connectors are edited as follows:

- Select a Link Connector by clicking it with the mouse.
- Choose 'Edit Link Connector' from the 'Link Connectors' pop-out menu on the Junction menu. This opens the Edit Link Connector dialog box.

**Edit Link Connector**

From Link: 1/1

To Link: 5/1

Mean Cruise Time (s): 10

Through The link Connector:

Route	Flow
5	800

Total Flow: 800

Platoon Dispersion

Use Platoon Dispersion

Platoon Dispersion Coefficient: 35

OK Cancel

- The Edit Link Connector dialog box allows the following settings to be changed:
  - **From Link.** The Link the Link Connector starts from.
  - **To Link.** The Link the Link Connector ends at.

- **Mean Cruise Time (sec).** The mean cruise time between two stop lines.
- **Platoon Dispersion.** Tick the Platoon Dispersion box to model platoon dispersion on the Link Connector. A Platoon Dispersion Coefficient can also be entered but should be left at its default of 35 unless detailed site data suggests otherwise. For very short Links, such as occur on a signal roundabout's circulatory carriageway platoon dispersion should be switched off. LinSig is unable to directly model platoon compression at this time; however it is often possible to allow for platoon compression on some movements by changing the Start/End Displacement on the Link.

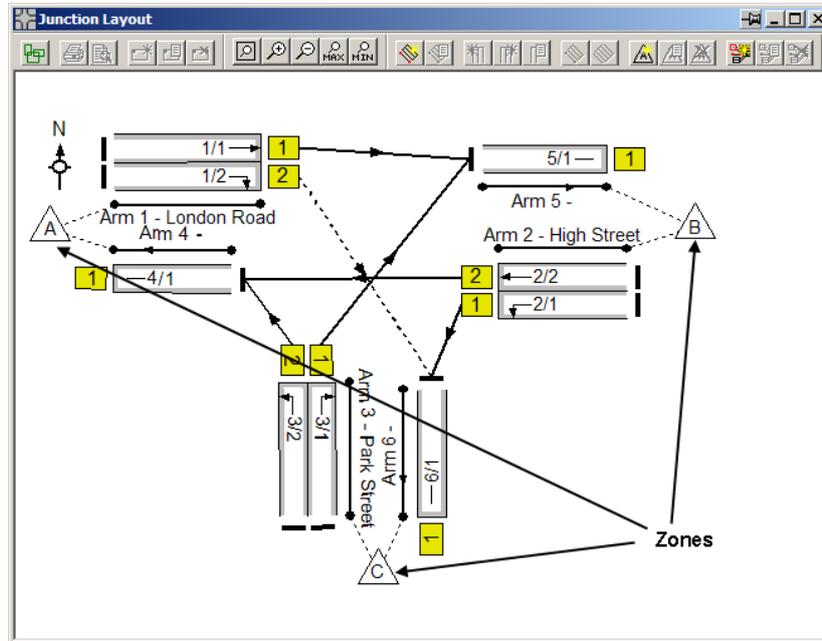
### 3.2.6.3. Deleting a Link Connector

A Link Connector can be deleted by selecting it with the mouse and choosing 'Delete Link Connector' from the 'Links' pop-out menu on the Junction menu.

Deleting a Link Connector also deletes any Routes passing through the Link Connector. Any traffic flow allocated to Routes which are deleted will be de-allocated and the Actual Flows Matrix in the Traffic Flows View will show a flow deficit reflecting this. The flow on Routes through the deleted Link Connector should be reallocated either to Routes through other Links Connectors or to any Routes through new Link Connectors replacing the deleted Link Connector. This can be done either manually using the Route List in the Traffic Flows View or by reallocating all flows to Routes by choosing 'Allocate OD Flows to Routes' from the Routes menu. More information is given in the section on the Traffic Flows View.

### 3.2.7. Defining Network Entry and Exit Points using Zones

Zones are used in LinSig to define entry and exit points to and from the modelled Network. Zones define the start and end point of traffic movements through the Network. All traffic flows start from a Zone and end at a Zone. Zones are also used in the Traffic Flows View to reference the start and end points of traffic movements entered in the Traffic Flow Views Origin-Destination matrices.

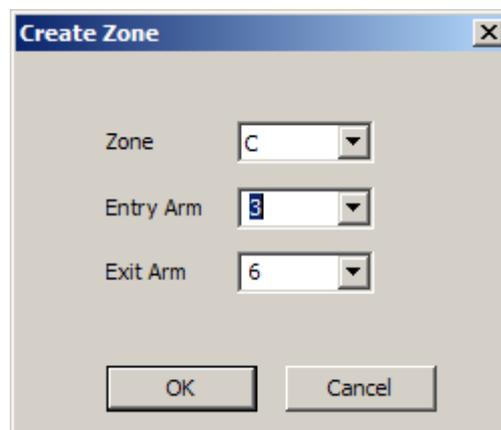


A Zone should be created for every point traffic enters or exits the Network. LinSig currently does not support Zones feeding traffic directly onto internal Links.

#### 3.2.7.1. Creating Zones

To create a Zone:

- Choose 'Create Zone' from the 'Zones' pop-out menu on the Junction menu.
- Position the Zone in the Junction Layout View and drop it by clicking with the mouse.
- The Create Zone dialog box is displayed to configure the new Zone.



- The Create Zone dialog box allows the following settings to be specified:
  - **The Zone's Name.** Zones are always named as a letter. Zones can be named in any order but there can be no gaps in the sequence of Zone

names. If a Zone is given the same name as an existing Zone the new Zone is inserted in the sequence and Zones later in the name sequence are renumbered.

- **Entry Arm.** The Network Entry Arm which the Zone feeds traffic too. Currently each Zone can only feed traffic to one Arm.
- **Exit Arm.** The Network Exit Arm which the Zone receives traffic from. Currently each Zone can only receive traffic from one Arm.
- Click 'OK' to create the Zone. The Zone displays dotted Zone Feeds in the Junction Layout View to indicate which Links it is feeding traffic to or accepting it from.

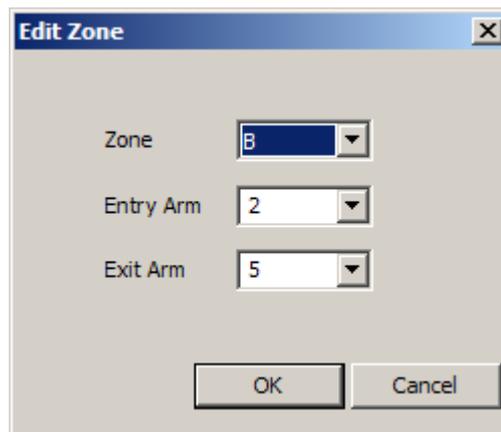
### 3.2.7.2. Repositioning Zones

A Zone can be repositioned by dragging it to its new position with the mouse.

### 3.2.7.3. Editing Zones

Zones are edited as follows:

- Select the Zone with the mouse.
- Choose 'Edit Zone' from the 'Zones' pop-out menu on the Junction menu.
- The Edit Zone dialog box is displayed which is identical to the Create Zone dialog described in 'Creating Zones' above.



- The Zones settings can be changed in the same way as described above in 'Creating Zones'.

Disconnecting a Zone from its entry or exit Arm will delete all Routes starting from or ending at the Zone depending on which Arm is disconnected. Any traffic flow allocated to Routes which are deleted will be de-allocated and the Actual Flows Matrix in the Traffic Flows View will show a flow deficit reflecting this. The flow on Routes through the disconnected Zone Connector should be reallocated to the new Routes created when the Zone is reconnected possibly to a different Arm. This can be done either manually using the Route List in the Traffic Flows View or by reallocating all flows to Routes by choosing 'Allocate OD Flows to Routes' from the Routes menu. More information is given in the section on the Traffic Flows View.

### 3.2.7.4. Deleting Zones

A Zone can be deleted by selecting it with the mouse and choosing 'Delete Zone' from the 'Zones' pop-out menu on the Junction menu.

Deleting a Zone also deletes any Routes originating or ending at the Zone and also deletes any traffic flows originating from or travelling to the Zone in the Traffic Flow View's Origin-

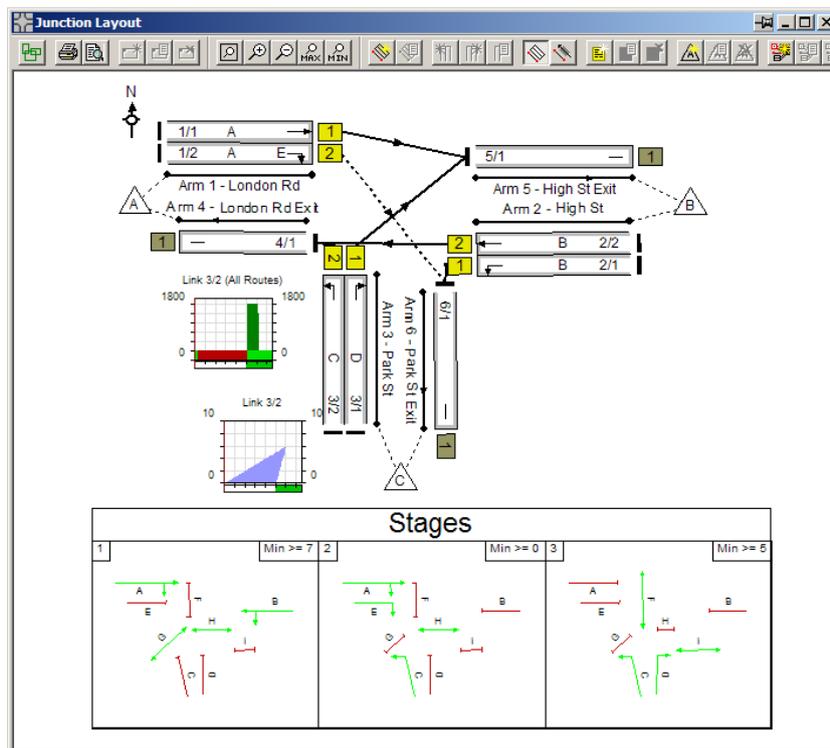
Destination Matrix. Zones should not be deleted unless you wish to delete its associated traffic flow data. When restructuring the Network instead of deleting the Zone a better option may be to disconnect the Zone from its entry and/or exit Arms and reconnect it to new Arms as appropriate.

### 3.2.8. Displaying Signal Staging on the Junction Layout View

LinSig can display a copy of the Stage View or Staging Plan View on the Junction Layout View. This is extremely useful when printing the network – especially larger networks as it allows the staging of the Junction to be concisely included on the main network diagram. Each Junction Layout View Stage Sequence displays one of the following:

- The available Stages from the Stage View for a single Stage Stream.
- The Stage order for a Staging Plan from the Staging Plan View for a single Stage Stream.

If desired multiple Stage Diagrams can be used for more than one Stage Stream.



#### 3.2.8.1. Adding a Stage Diagram to the Junction Layout View

A Stage Diagram can be added to the Junction Layout View as follows:

- Choose 'Add Stage Diagram' from the 'Stage Diagram' pop-out menu on the Junction menu.
- Click on the Junction Layout View where you wish to create the Stage Diagram. The 'Edit Stage Diagram' dialog box appears to allow you to set the diagrams options.
- Select the mode of the Stage Diagram. The mode governs what the Stage Diagram shows. The options are:
  - **Show Available Stages.** This option displays all the Stages defined in the Stage View and represents all the available Stages configured in the Controller. The Stages are ordered by Stage number and are therefore not necessarily in the order in which the Stages are run.
  - **Show Staging Plan Sequence.** This option shows the Stage Sequence for the Staging Plan associated with the current Scenario. As the current scenario changes the Stage Diagram changes to reflect the Stage Sequence for the new current Scenario.

- Select the Layout of the Stage Diagram. This setting governs how the different Stage boxes are laid out within the overall Stage Diagram. This setting can usually be set to 'Auto' but where this does not provide a sensible layout the Layout option can be used to provide several alternative layouts.
- Click OK to create the Staging Diagram.

### **3.2.8.2. Repositioning and Resizing a Stage Diagram**

A Stage Diagram can be repositioned by dragging the diagram with the mouse. It can also be resized by dragging any or the diagram's borders or corners with the mouse.

### **3.2.8.3. Editing a Stage Diagram**

A Stage Diagram can be edited by double clicking with the mouse. This will open the 'Edit Stage Diagram' dialog box which can be used to edit the Stage Diagram's settings as described in 'Adding a Stage Diagram to the Junction layout View' above.

### **3.2.8.4. Changing the Appearance of the Stage Diagram**

The graphical appearance of the Stage Diagram is inherited from either the appearance of the Stage View or the Staging Plan View.

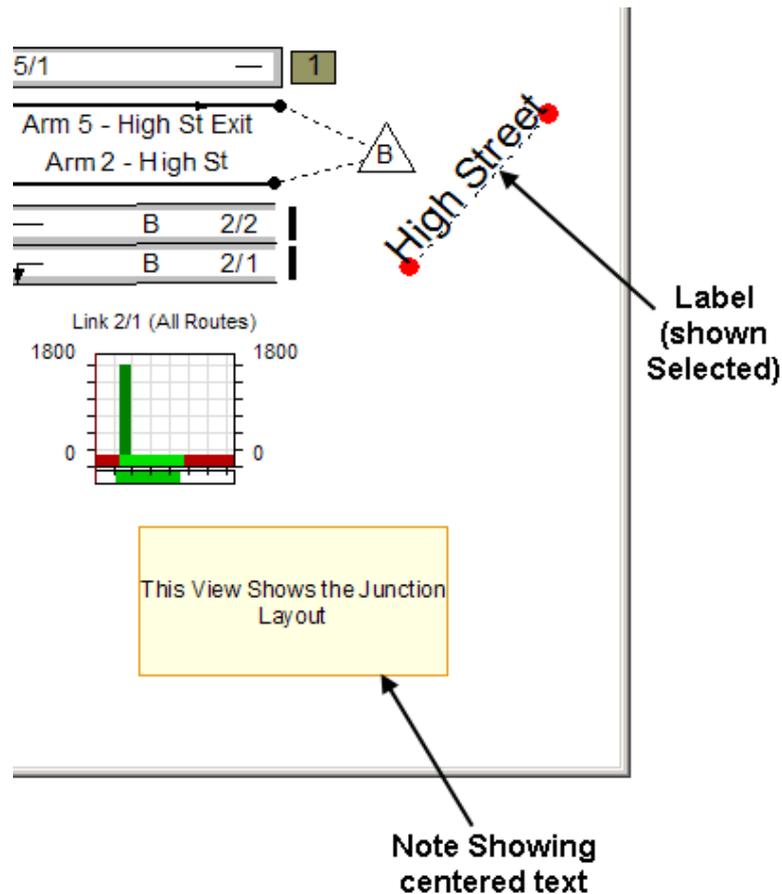
### **3.2.8.5. Deleting a Stage Diagram**

A Stage Diagram can be deleted by selecting it with the mouse and choosing 'Delete Stage Diagram' from the 'Stage Diagram' pop-out on the Junction Menu.

### 3.2.9. Annotating the Junction Layout View

The Junction Layout View can be annotated using Notes and Labels. These are used as follows:

- Notes are used to place paragraphs of formatted text on the Junction Layout View. They can be formatted in any font, size or colour and justification and are displayed in a coloured background rectangle. They can be thought of as similar to Post-It notes. Notes can also be used on the Phase View.
- Labels are used to position single lines of text on the View at any angle. They can also be displayed with any font size and colour.



#### 3.2.9.1. Working with Notes on the Junction Layout View and Phase View

Notes can be used anywhere on the Junction Layout View or Phase View as described below.

##### Adding Notes to the Junction Layout and Phase View

A Note is added to the Junction Layout View as follows:

- Choose 'Add Note' from the 'Notes' pop-out on the Junction Menu.
- Click anywhere on the Junction Layout View to drop the new empty Note.
- Edit the Note's text as described below in 'Editing a Note'.

## **Editing a Note**

The text of a Note can be edited as follows:

- Double click on a Note to open the Note Editor. The Note Editor displays the Note's text (if any) and formatting options for the Note.
- Enter the Note's text.
- Click OK to save the Note's text.

## **Formatting a Note**

The Note Editor allows the font, colour and size of text to be set for individual paragraphs, words and characters as well as the Note as a whole. To change the formatting of all or part of the Note:

- Select the text you wish to change the formatting for. The current format for the selected text is shown in the settings boxes on the Note Editor's main toolbar.
- Choose a new font, font size, colour and other options such as bold and underline.
- Some settings such as justification, centring and bullet point only apply to a whole paragraph. A background colour can also be selected which applies to the whole Note.
- When all formatting changes have been made click OK to apply the changes to the Note.

## **Repositioning and Resizing a Note**

Each Note can be moved by dragging with the mouse and resized by dragging the Note's borders or corners with the mouse. Each paragraph within the Note will be wrapped to fit within the Note's borders.

### **3.2.9.2. Working with Labels on the Junction Layout View**

Labels can be used as an alternative to Notes on the Junction Layout View.

#### **Adding Labels to the Junction Layout View**

A Label is added to the Junction Layout View as follows:

- Choose 'Add Label' from the 'Labels' pop-out on the Junction menu.
- Click anywhere on the Junction Layout View to drop the Label. The 'Create Label' dialog box will appear.
- Set the Label's text, colour and Font.
- Click OK to create the Label.

#### **Editing a Label**

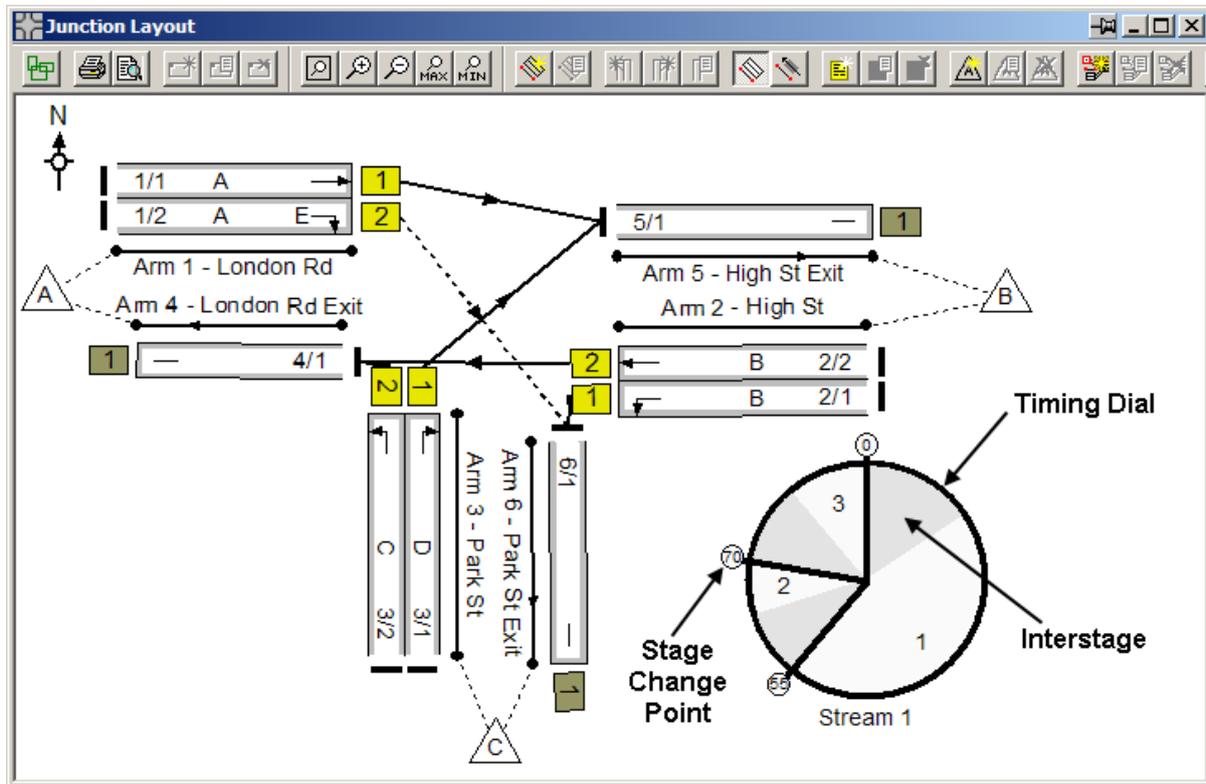
A Label can be edited by double clicking with the mouse and changing its settings as described in 'Adding Labels to the Junction Layout View' above.

#### **Repositioning a Label**

A Label can be repositioned by selecting it with the mouse and then dragging either the centre of the Label move the whole Label, or one of the red handles at the end of the Label to change the Labels orientation.

### 3.2.10. Displaying and Using Timing Dials

Timing Dials allow the signal timings for a Stage Stream to be displayed and changed directly on the Junction Layout View. This is useful with larger Networks when there is insufficient screen space to view both the Junction Layout View and the Signal Timings View at the same time. It also provides a concise overview of signal times for all Stage Streams when printed on the Junction Layout View.



#### 3.2.10.1. Adding a Timing Dial to the Junction Layout View

To add a Timing Dial to the Junction Layout View:

- Choose 'Add Timing Dial' from the 'Timing Dials' pop-out on the LinSig Junction Menu.
- Position the Timing Dial on the Network Diagram and click to drop the Dial. The 'Create Timing Dial' dialog box opens allowing options to be set.
- Set the options for the new Timing Dial. Available options include:
  - **Stage Stream.** Each Timing Dial shows information for a single Stage Stream. The Stage Stream option specifies which Stage Stream this Timing Dial displays.
  - **Show Title.** Select whether to display the Stream name next to the Timing Dial.
  - **Show Timings in Grab Handles.** If the Timing Dial is large enough this option can be used to display the stage change point values in each of the stage change point handles.
  - **Set Timing Dial Size.** Sets the size of the Timing Dial.
- Click OK to close the 'Create Timing Dial' dialog box and display the new Timing Dial.

- The Timing Dial will always show the Stage lengths for the current Scenario. If the current Scenario is changed the Timing Dials will change to reflect the Stage lengths in the new current Scenario.

### **3.2.10.2. Editing the Settings for a Timing Dial**

An existing Timing Dial's settings can be edited at any time by double clicking the Timing Dial. This will open the 'Edit Timing Dial' dialog box which can be used to change it's settings as described above in 'Adding a Timing Dial to the Junction Layout View'.

### **3.2.10.3. Deleting a Timing Dial**

To delete a Timing Dial select the Dial with the mouse and choose 'Delete Timing Dial' from the 'Timing Dials' pop-out on the Junction Menu. Alternatively right click on the Dial and choose 'Delete Timing Dial' from the pop-up menu.

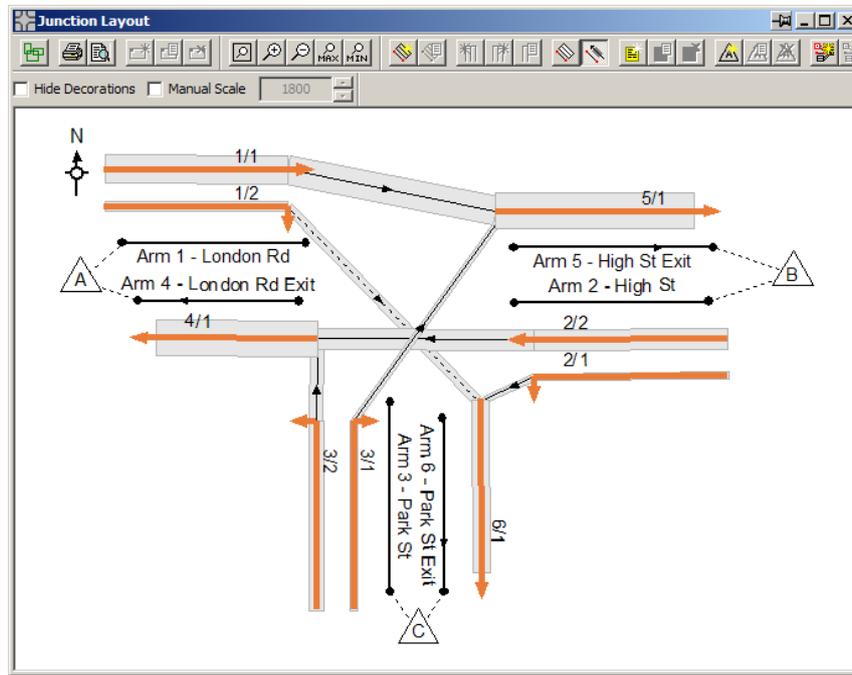
### **3.2.10.4. Adjusting Signal Settings using a Timing Dial**

As well as displaying the Stage lengths for the current Scenario the Timing Dial can be used to adjust the Stage Lengths as follows:

- Click on any Timing Dial stage change point handle and drag with the mouse. LinSig will update the other views with the new stage times.
- All minimums, intergreens etc. are complied with as part of the dragging process.
- If Flow Profile and Queue Graphs are also displayed on the Junction Layout View they are dynamically updated as the stage change points are changed. This makes the combination of Timing Dials and embedded graphs very powerful for manually adjusting signal timings to achieve a specific result. For example using the Timing Dials and graphs it is easy to manually coordinate Links to achieve front end or back end coordination and to monitor/limit queues on specific Links.

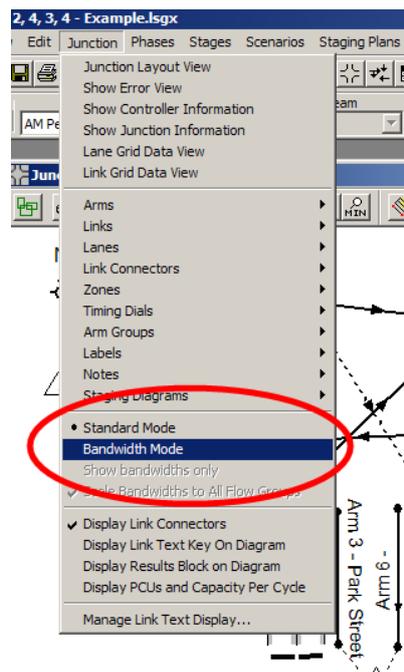
### 3.2.11. Displaying Link Bandwidths on the Junction Layout View

Link Bandwidths display the Traffic Flows passing through a Junction or Network by using variable width bands on each Link and Link connector where the width of the band is proportional to the traffic flow on the Link or Connector. Although useful in any size of Network the Bandwidths are particularly useful for larger networks with more complex flow patterns.



#### 3.2.11.1. Displaying Bandwidths

Bandwidths can be displayed by choosing 'Bandwidth Mode' from the Junction Menu. The Junction Layout View will change its appearance to display the Bandwidths, with a simplified display of Links to avoid obscuring the Bandwidths. The Bandwidths can be removed by choosing 'Standard Mode' from the Junction Menu.



### 3.2.11.2. Bandwidth Options

A number of options are available to control the display of Bandwidths. These include:

- **Show Bandwidths Only/Hide Decorations.** Choosing 'Show Bandwidths Only' from the Junction Menu or ticking 'Hide Decorations' on the Junction Layout View's toolbar hides the display of Links in Bandwidth Mode. This is sometimes useful in displaying a cleaner less cluttered view.
- **Scale Bandwidths to All Flow Groups.** If 'Scale Bandwidths to All Flow Groups' is selected on the Junction menu LinSig will scale all Bandwidths so as to ensure Bandwidths for different Flow Groups are comparable. If this option is set the Bandwidth scale is set so the highest Link flow in all Flow Groups will sensibly fit on the Bandwidth diagram. If this option is not set the diagram will be scaled to the highest flow in the current Scenario's Flow Group.
- **Manual Scale.** If the Manual Scale option is selected on the Junction Layout View Toolbar the Bandwidth scale can be set manually. This scale will apply to all Flow Groups.

### 3.3. Traffic Flows View

The Traffic Flows View is used to carry out the following tasks:

- Create and manage Traffic Flow Groups.
- Specify traffic flows by entering origin-destination matrices for each Flow Group.
- Specify or Edit Route Flows for each Flow Group.

The View can be opened by choosing 'Traffic Flows View' on the Traffic Flows menu.

**Flow Groups**

Num	Description	Start	End	Duration
F1	2006 AM Peak (Current Scenario)	08:00	09:00	01:00
F2	2006 PM Peak	16:30	17:30	01:00

**Route List**

Route	Org Zone	Dest Zone	Org Link	Dest Link	Flow	Flow Locked ?
1	B	A	2/2	4/1	600	
2	A	C	1/2	6/1	300	
3	C	A	3/2	4/1	400	
4	C	B	3/1	5/1	200	
5	A	B	1/1	5/1	800	
6	B	C	2/1	6/1	200	

**Origin-Destination Matrix**

Origin	Destination			Tot.
	A	B	C	
A	0	800	300	1100
B	600	0	200	800
C	400	200	0	600
Tot.	1000	1000	500	2500

If the 'Auto-Allocate OD flows' button is pressed, any changes made to the Desired Flows data in the matrix will automatically be allocated to Routes. If the 'Auto-Allocate OD flows' button is not pressed, the Desired Flows entered here will not be allocated to Routes until the 'Allocate Flows...' button is pressed.

#### 3.3.1. Defining Traffic Flows in LinSig

LinSig defines Traffic Flows through the Network in the following manner:

- Traffic Flow Groups are used to define any number of different sets of traffic flows. 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. Traffic Flow Groups can also be defined as combinations of other Flow Groups. Each Flow Group stores a set or Origin-Destination matrices and a set of Route Flows specific to itself. It is assumed that the traffic demands and Route Flows are constant throughout the modelled time period.
- Each Traffic Flow Group contains a Demand Flow Origin-Destination (OD) matrix which specifies the amount of traffic wishing to move from each Zone to each other Zone.
- Each Traffic Flow Group also stores a set of Route Flows which specify the traffic flow on every Zone-to-Zone Route through the Network. The Route Flows are obtained by assigning the Desired OD matrix flows to Routes through the Network. This can be carried out manually or with assistance from LinSig as described below.
- LinSig uses the Route Flows to calculate all other flow information such as Link Flows and turning flows.

The use of Routes rather than directly specifying traffic flows separately for each Link has the following benefits:

- More information is available to LinSig regarding the detailed traffic movements on each Link leading to improved model accuracy.
- Errors due to entering erroneous inconsistent flows on Links are eliminated.
- Better control and checking of aggregate traffic levels is possible.
- The more structured Network makes it easier to extract more detailed information such as travel time matrices in the future.

### 3.3.2. Using the Traffic Flows View

The Traffic Flows View is split into several parts called 'panels'. These are:

- **The Traffic Flow Group List.** The Traffic Flow Group List shows the different Traffic Flow Groups defined in LinSig. The list also shows Flow Group currently being displayed and edited in rest of the Traffic Flow View and the Flow Group currently being used in traffic model calculations.
- **The Origin-Destination (OD) Matrices.** The matrix display 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 Network's Route Flows.
- **The Route List.** This lists all the Routes through the Network and the traffic flow assigned to each Route for the selected Flow Group.
- **The Route Filter.** The Route Filter allows the Route List to be filtered to only show Routes matching different criteria. This is useful with larger Networks which contain many Routes.

#### 3.3.2.1. The Traffic Flow Group List

The Traffic Flow Group List displays the currently defined Flow Groups and allows new Flow Groups to be created and edited. A new LinSig model is always created with an empty Flow Group already defined.

The screenshot shows a software window titled "Traffic Flows View". Inside, there is a table with the following data:

Flow Groups					
Num	Description	Start	End	Duration	
F1	2006 AM Peak (Current Scenario)	08:00	09:00	01:00	
F2	2006 PM Peak	16:30	17:30	01:00	

Below the table, there are two panels: "Route List" on the left and "Origin, Destin" on the right.

The Flow Group List shows the following information for each Flow Group:

- **Flow Group Number.** A unique reference number for the Flow Group.
- **Description.** A text description of the Flow Group.
- **Start Time.** The time of day the Flow Group starts.
- **End Time.** The time of day the Flow Group ends.
- **Duration.** The duration of the Flow Group.
- **The Selected Flow Group.** The Selected Flow Group is highlighted in red. The Selected Flow Group is the Flow Group which is shown and edited in the other

panels in the Traffic Flow View. It is not necessarily the Flow Group being used for model calculations. The Selected Flow Group can be changed by clicking a Flow Group in the Flow Group List.

- **The Current Scenario Flow Group.** The Flow Group currently being used for model calculations is inferred by the current Scenario selected in the Scenario View and is shown in bold and labelled '(current Scenario)' in the Traffic Flow Groups List. It is changed by selecting a new current Scenario in the Scenario View. When the Current Scenario is changed LinSig will recalculate model results using the Flow Group and other settings from the new Current Scenario.

### Creating a New Flow Group

To create a new Flow Group choose 'Add Flow Group' from the Traffic Flows menu. A new Flow Group with a default name and time period is created at the end of the Flow Group List. The new Flow Group can be edited as described in 'Editing Flow Groups' below.

### Inserting a Flow Group into the Flow Group List

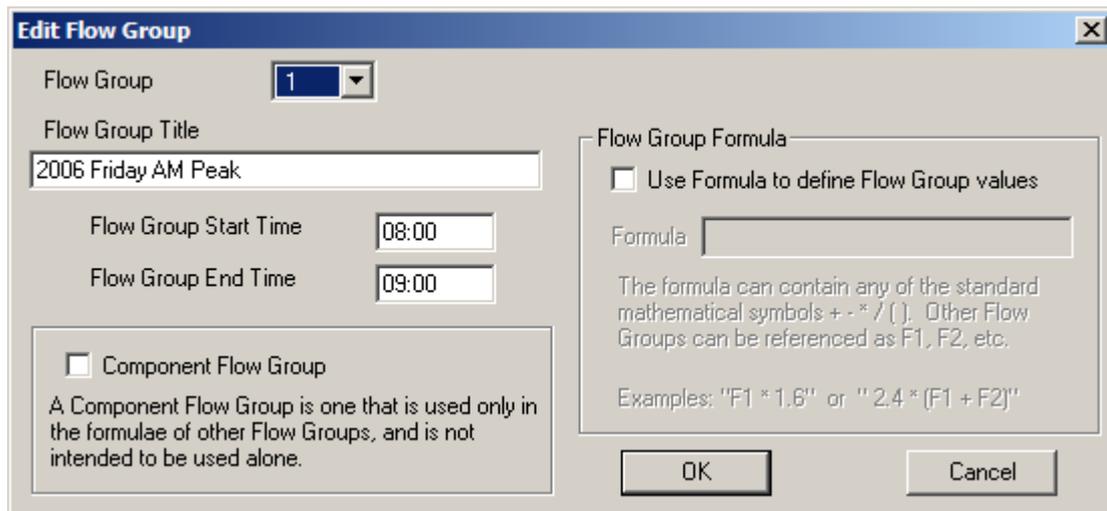
A new Flow Group can be inserted at any position in the Flow Group List as follows:

- Select a Flow Group next to where the new Flow Group is needed.
- Choose 'Insert Flow Group After Selected Flow Group' or 'Insert Flow Group Before Selected Flow Group' from the Traffic Flows menu as appropriate. A new Flow Group is created and inserted into the Flow Group List.
- The new Flow Group can be edited as described in 'Editing Flow Groups' below.

### Editing a Flow Group's Details

Editing a Flow Group's traffic flow information is covered below in the section 'Origin-Destination Matrices'. A Flow Group's general details, other than traffic flow information, can be edited as follows:

- Select the Flow Group in the Flow Group List.
- Choose 'Edit Flow Group' from the Traffic Flows menu.
- The Edit Flow Group dialog box is displayed.



- The Edit Flow Group dialog box allows the following Flow Group settings to be edited:
  - **Flow Group Number.** A Flow Group can be renumbered by changing its Flow Group Number. Flow Group numbers must be sequential with

no gaps in the sequence. If the Flow Group is given the same number as an existing Flow Group the Flow Group will be inserted into the sequence and the existing and higher number Flow Groups will be renumbered.

- **Flow Group Title.** Each Flow Group should be given a meaningful title.
  - **Flow Group Start Time.** The Flow Group Start Time should be specified using the 24 hour clock in the format hh:mm.
  - **Flow Group End Time.** The Flow Group End Time should be specified using the 24 hour clock in the format hh:mm.
  - **Component Flow Group.** A Component Flow Group is a Flow Group which is used **only** as a component of another Flow Group in a Flow Group Formula. Typically running or reporting a model using just a single Flow Group Component would not be correct. Marking a Flow Group as a Component Flow Group prevents the Flow Group from being selected as the Flow Group for analysis and also omits them where relevant from reports. Setting a Flow Group to be a component Flow Group has no affect on calculations
  - **Flow Group Formula.** This is covered below in 'Defining Flow Groups using Formulae'.
- Click OK to finish editing the Flow Group.

### Deleting a Flow Group

A Flow Group can be deleted by selecting it in the Flow Groups List and choosing 'Delete Flow Group' from the Traffic Flows menu.

Deleting a Flow Group also deletes all associated traffic information such as Origin-Destination matrices and Route Flows for the deleted Flow Group.

### Defining Flow Groups using Formulae

Traffic Flow Groups are often built up by combining a number of component sets of traffic data to form a new composite set of traffic flows. For example in a development context a Flow Group may be defined as a set of base traffic flows plus development generated traffic flows. A more complex example may involve growthing the base traffic to a future year before combining it with development flows from a number of different (and usually ever changing) development scenarios.

LinSig allows Traffic Flow Groups to be defined as combinations of other previously defined Flow Groups. Formulae are used to combine Flow Groups in any combination. For example if the base traffic is Flow Group 1 (F1) and Development scenario A is Flow Group 2 (F2), a new combined Flow Group 3 (F3) could be defined using the Formula  $F3 = 1.06 * F1 + F2$ . This will factor up the base traffic by 6% before adding the development traffic. A Flow Group does not have to be defined as a Component Flow Group to be used in a formula. Component Flow Groups are Flow Groups which are used only in formulae.

Flow Group Formula

Use Formula to define Flow Group values

Formula

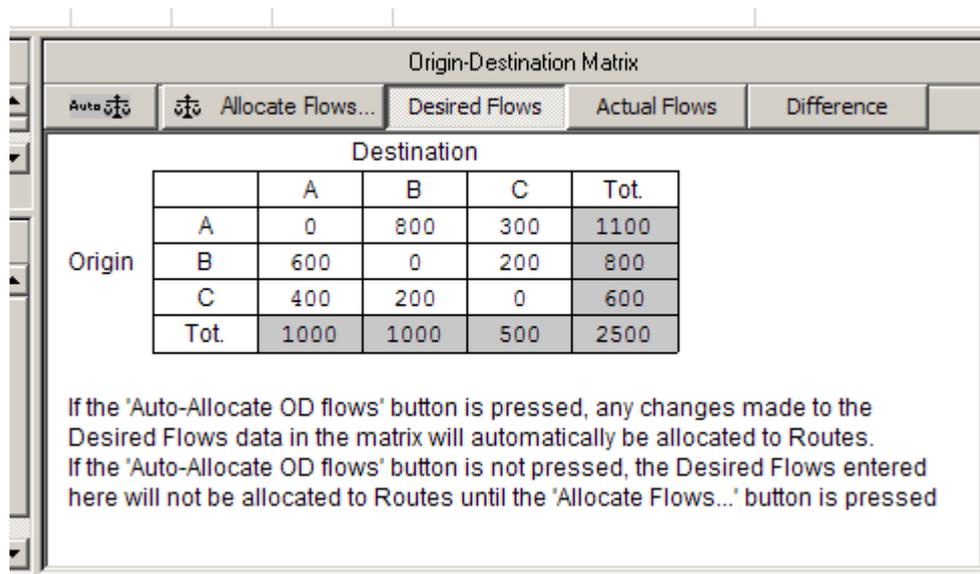
The formula can contain any of the standard mathematical symbols + - \* / ( ). Other Flow Groups can be referenced as F1, F2, etc.

Examples: "F1 \* 1.6" or "2.4 \* (F1 + F2)"

A Formula based Flow Group can be defined by ticking the 'Use Formula to Define Flow Group Values' box in the Edit Flow Group dialog box, and specifying a formula. Any common mathematical operators such as +, -, \* and / can be used as can brackets () to specify precedence.

### 3.3.2.2. The Origin-Destination Matrices

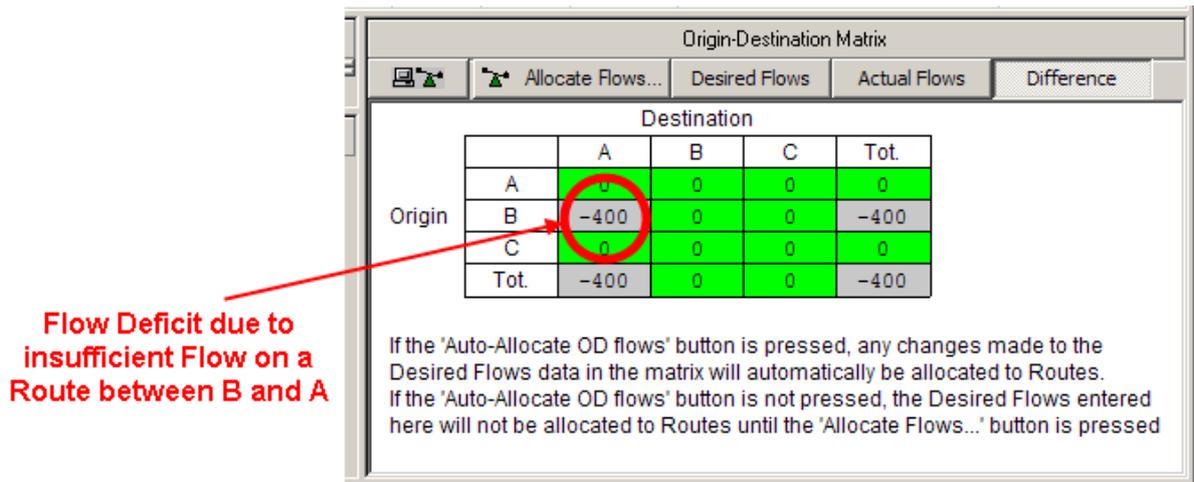
LinSig uses Origin-Destination (OD) matrices to specify total Zone-to-Zone traffic movements through the Network. Each Traffic Flow Group uses OD matrices to specify traffic flows in PCU between Zones for the duration of the modelled time period. For example a Flow Group of duration 15 minutes would have 15 minutes flows entered. The matrices are viewed and edited in the right hand panel of the Traffic Flows View.



#### Traffic Flow Matrices

Each LinSig Traffic Flow Group uses three types of traffic flow matrices, one for input and two for output/error checking. 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. The Desired Flows Matrix is the traffic data used by LinSig when automatically allocating traffic flows to Routes.
- **Actual Flows Matrix.** The Actual Flows Matrix is derived from the traffic flows assigned to each Route as described in the Route List section 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 as is shown in the Desired Flows Matrix
- **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 using the Route List Panel as detailed below. This will ensure the total Zone-to-Zone Route Flows equal the desired Zone-to-Zone traffic movements.

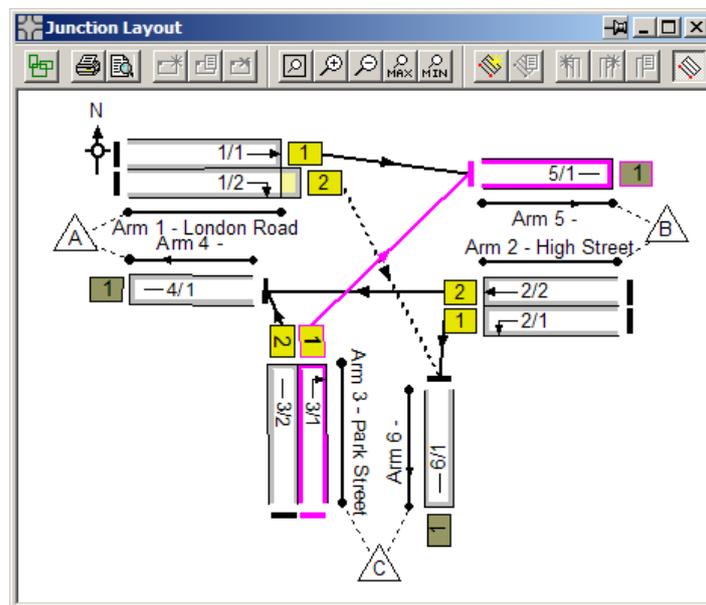


### Viewing and Editing the OD Matrices

The Traffic Flow Matrices are displayed and edited in the Traffic Flows View. Each of the three different matrices can be displayed by clicking on the appropriate button on the toolbar above the matrices. Only the Desired Flows matrix can be edited, the Actual and Difference Flow matrices being for display purpose only.

### 3.3.2.3. The Route List

A Route represents a unique path through the Network from one Zone to another. As each Route is comprised of a sequence of individual Links and Link Connectors, a number of different Routes can exist between any two Zones. Each of the Routes represents a different choice of Links for drivers travelling between two Zones.



The main purpose of Routes is to specify traffic flows through the Network at a very detailed level. Each Route is allocated a traffic flow either manually or automatically. LinSig then aggregates the Route traffic flows to calculate Link flows and any other traffic flow information required.

The Route List lists all the Routes through the Network. LinSig scans the Network whenever its structure changes and discovers any new Routes created, adding them to the Route List.

Route List						
Route	Org Zone	Dest Zone	Org Link	Dest Link	Flow	Flow Locked ?
1	B	A	2/2	4/1	600	
2	A	C	1/2	6/1	300	
3	C	A	3/2	4/1	400	
4	C	B	3/1	5/1	200	
5	A	B	1/1	5/1	800	
6	B	C	2/1	6/1	200	

The Route List displays the following information for each Route:

- **Route Number.** Each Route is given a unique Index number which identifies it.
- **Origin Zone.** The Zone the Route starts from.
- **Destination Zone.** The Zone where the Route ends.
- **Origin Link.** The Link the Route starts from.
- **Destination Link.** The Link where the Route Ends.
- **Flow.** The traffic flow on the Route in PCU.
- **Flow Locked?** Whether the Route Flow can be modified by the automatic flow assignment.

The List can be sorted by any of the above criteria by clicking on a column header.

### Selecting a Route

A Route is selected by clicking on it with the mouse in the Route List. The Route is highlighted in the indicating it is selected. The Route is also highlighted in the Network diagram in the Junction Layout View.

### Editing a Route Flow

The traffic flow allocated to a Route can be manually edited by selecting the Route in the Route List and choosing 'Edit Route Flow' from the Routes menu. The Edit Route Flow dialog box appears which allows the Route Flow in PCU to be specified.

Link Flows in the Junction Layout View and Link Results View, and the Actual Flows matrix in the Traffic Flows View are updated to reflect the new Route Flow. The traffic model also calculates new results based on the new Route Flow.

## Locking a Route Flow

When editing a Route ticking the 'Lock this Flow value when balancing' box prevents the Route's flow from being changed when carrying out automatic flow assignment as described below. This is typically used to manually specify and Lock the traffic flow on some Routes on an Arm and balance the remaining flow between the remaining non-locked Routes. More information is provided in 'Allocating the Traffic Flow Matrices to Routes using the Route List' below.

## Setting Non-Permitted Routes

Sometimes LinSig will discover Routes which although logically valid Routes through the Network wouldn't in practice be used by traffic. LinSig allows Routes to be defined as non-permitted meaning that LinSig will never allow any traffic to be allocated to the Route.

Route List							
Route	Permitted	Org Zone	Dest Zone	Org Link	Dest Link	Flow	Flow Locked ?
1	<input checked="" type="checkbox"/>	B	A	2/2	4/1	600	
2	<input checked="" type="checkbox"/>	A	C	1/2	6/1	300	
3	<input checked="" type="checkbox"/>	C	A	3/2	4/1	400	
4	<input checked="" type="checkbox"/>	C	B	3/1	5/1	200	
5	<input checked="" type="checkbox"/>	A	B	1/1	5/1	800	
6	<input checked="" type="checkbox"/>	B	C	2/1	6/1	200	

To specify Routes as non-permitted choose 'Edit Permitted Routes' from the Routes menu or tick the 'Edit Permitted Routes' box on the Route Filter. The Route List displays a tick box next to each Route in the Route List. Un-ticking a tick box specifies a Route as non-permitted and sets its Route Flow to zero.

## The Route Filter

The Route Filter allows the Route List to be filtered to show only Routes matching a filter criterion defined in the Route Filter. This is useful with larger Networks which contain many Routes. As well as showing only filtered Routes in the Route List the Junction Layout View also highlights the currently filtered Routes.

Route Filter

Edit Permitted Routes

Filter (show only routes that match):

Origin

Zone: All

Arm: All

Link: All

Contains

Arm: All

Link: All

Destination

Zone: All

Arm: All

Link: All

Reset

Reset

Reset

A Route Filter can contain any or all of the following criteria:

- Route Origin Zone, Arm or Link.
- The Route Destination Zone, Arm or Link,
- An Arm or Link which a Route passes through.

Only Routes which match all three criteria will be included in the Filtered Route List.

The figures below show a Route Filter set in the Route List and the filtered display of Routes on the Junction Layout View.

If a Route Filter has been set it can be removed by clicking one or more of the 'Reset' buttons below each section of the Route Filter.

Route List						
Route	Org Zone	Dest Zone	Org Link	Dest Link	Flow	Flow Locked ?
2	A	C	1/2	6/1	300	
5	A	B	1/1	5/1	800	

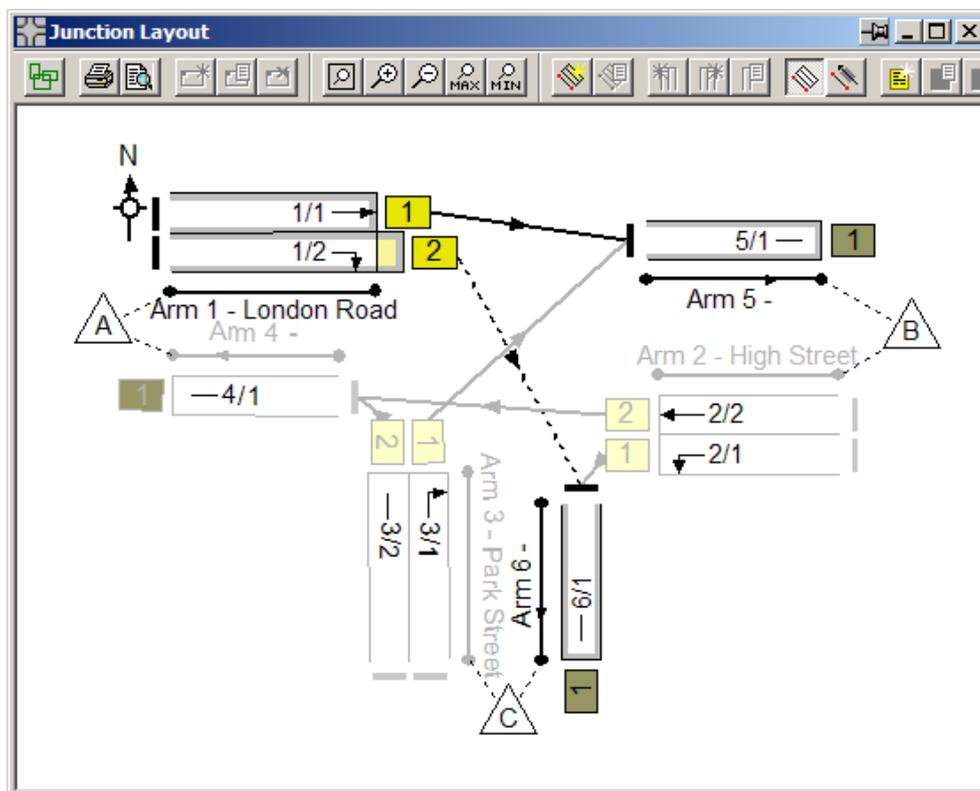
  

Route Filter

Filter (show only routes that match):  Edit Permitted Routes

<p>Origin</p> <p>Zone: <input type="text" value="A"/></p> <p>Arm: <input type="text" value="1"/></p> <p>Link: <input type="text" value="All"/></p> <p style="text-align: center;">Reset</p>	<p>Contains</p> <p>Arm: <input type="text" value="All"/></p> <p>Link: <input type="text" value="All"/></p> <p style="text-align: center;">Reset</p>	<p>Destination</p> <p>Zone: <input type="text" value="All"/></p> <p>Arm: <input type="text" value="All"/></p> <p>Link: <input type="text" value="All"/></p> <p style="text-align: center;">Reset</p>
---	---	--

**Filtered Route List**



**Junction Layout View with Filter Applied**

### 3.3.2.4. Allocating the Traffic Flow Matrices to Routes using the Route List

As explained above in 'Defining Traffic Flows in LinSig', when the Desired OD Matrix has been specified the total traffic flows between Zones must be assigned to Routes to obtain a set of Route Flows for each Flow Group. The Route List panel of the Traffic Flows View is used to display Routes through the Network and allows the Routes to be assigned traffic flows and managed in other ways.

#### Assigning the Origin-Destination Matrix to Routes

Traffic flows can be assigned to Routes in two ways. These are:

- **Manually assigning a traffic flow to each Route.** This method provides more flexibility and control as the flow patterns can be refined to a high level of detail. It can however be time consuming with larger Networks.
- **Automatically assigning traffic flows to each Route based on the Desired Origin-Destination matrix.** This method is significantly faster than manually allocating flows but may not always arrive at a perfect solution where significant choice of Routes exists in the Network. Normally a mix of the two methods is used. The Automatic allocation is used to initially assign flows to Routes and then the resulting Route Flows are examined and manually adjusted where necessary to obtain an acceptable routing pattern.

The Traffic Flows View monitors the total aggregate amounts of traffic allocated to Routes in the Actual Flows Matrix and provides a check that the flows allocated to Routes match the Desired Origin-Destination matrix.

#### Manually assigning Traffic Flows to Routes

Traffic flows can be assigned to each Route independently by editing the traffic flow on each Route as described in 'Editing a Route Flow' above. It is your responsibility to ensure that the sum of Route Flows between any two Zones equals the total desired Zone to Zone flows specified in the Desired Flows Matrix. The Difference Matrix, described in more detail above, is useful in checking for any mismatches between the Desired Flows Matrix and total Route Flows between Zones.

#### Automatically Assigning the Desired Flows OD Matrix to Routes

To assign the Desired OD matrix to the Routes through the Network listed in the Route List choose 'Allocate OD Flows to Routes' on the Traffic Flows menu or click the 'Allocate Flows' button on the Traffic Flow View toolbar. LinSig will assign each Zone-to-Zone movement in the Desired Flows OD matrix to the Routes between the Zones. Where multiple Routes exists between Zones LinSig will attempt to balance traffic flows between Routes so as to as near as possible achieve equal lane flows on the junction's entry Arms.

**Flow Groups**

Num	Description	Start	End	Duration
F1	2006 Friday AM Peak (Current Scenario)	08:00	09:00	01:00
F2	2006 PM Peak	16:30	17:30	01:00

**Route List**

Route	Org Zone	Dest Zone	Org Link	Dest Link	Flow	Flow Locked ?
1	B	A	2/2	4/1	600	
2	A	C	1/2	6/1	300	
3	C	A	3/2	4/1	400	
4	C	B	3/1	5/1	200	
5	A	B	1/1	5/1	800	
6	B	C	2/1	6/1	200	

**Origin-Destination Matrix**

	Destination			
	A	B	C	Tot.
Origin A	0	800	300	1100
Origin B	600	0	200	800
Origin C	400	200	0	600
Tot.	1000	1000	500	2500

If the 'Auto-Allocate OD flows' button is pressed, any changes made to the Desired Flows data in the matrix will automatically be allocated to Routes. If the 'Auto-Allocate OD flows' button is not pressed, the Desired Flows entered here will not be allocated to Routes until the 'Allocate Flows...' button is pressed

**Automatically Assign Desired Flows Matrix**

The OD matrix can be re-assigned to the Routes at any point however this will replace the Flows on all non-locked Routes losing any customised Route Flows if they have been defined.

### Using Locked Routes

If a Route is specified as 'Locked', as described above in 'The Route List', the automatic assignment will not change the Route Flow. The Route Flow will still be taken into account in the assignment calculation and other Routes will be assigned around the locked Routes to give the most balanced flow assignment possible subject to not changing the flows on locked Routes.

### Automatically Re-Assigning Flows when the Desired OD Matrix Changes

When traffic data in the Desired Flows OD Matrix changes it is necessary to re-assign the new OD flows to the Routes. This can be carried out by repeating the assignment procedure described in 'Automatically Assigning the Desired Flows OD Matrix to Routes' above. Alternatively if 'Auto-Reassign Flows' is selected using the button on the Traffic Flow View toolbar LinSig will automatically reassign the matrix to the Routes whenever the Desired Flows Matrix changes. This will of course replace the flows on all affected Routes losing any custom Route Flows.

**Flow Groups**

Num	Description	Start	End	Duration
F1	2006 Friday AM Peak (Current Scenario)	08:00	09:00	01:00
F2	2006 PM Peak	16:30	17:30	01:00

**Route List**

Route	Org Zone	Dest Zone	Org Link	Dest Link	Flow	Flow Locked ?
1	B	A	2/2	4/1	600	
2	A	C	1/2	6/1	300	
3	C	A	3/2	4/1	400	
4	C	B	3/1	5/1	200	
5	A	B	1/1	5/1	800	
6	B	C	2/1	6/1	200	

**Origin-Destination Matrix**

	Destination			
	A	B	C	Tot.
Origin A	0	800	300	1100
Origin B	600	0	200	800
Origin C	400	200	0	600
Tot.	1000	1000	500	2500

If the 'Auto-Allocate OD flows' button is pressed, any changes made to the Desired Flows data in the matrix will automatically be allocated to Routes. If the 'Auto-Allocate OD flows' button is not pressed, the Desired Flows entered here will not be allocated to Routes until the 'Allocate Flows...' button is pressed

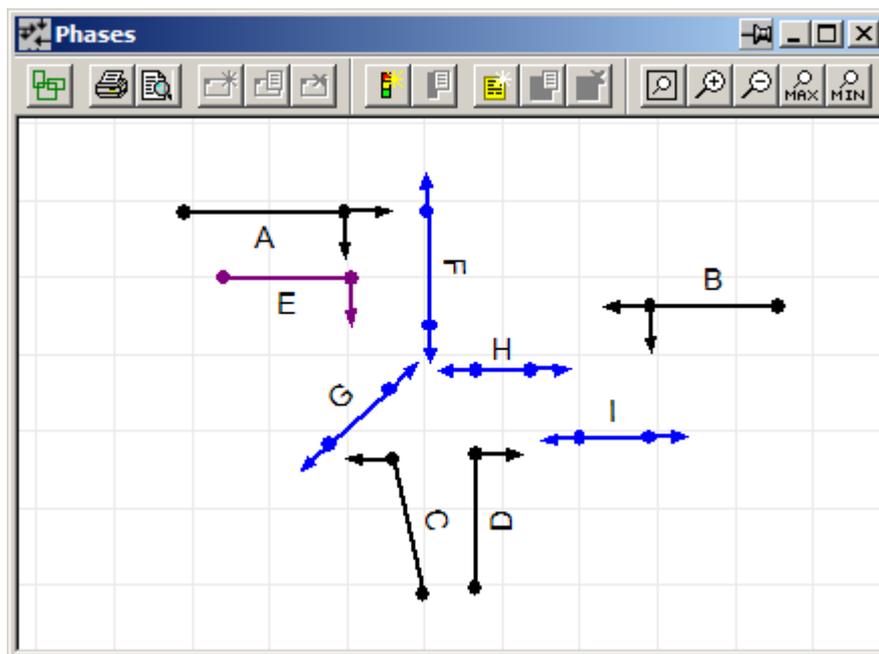
**Automatically Reassign Desired Flows Matrix when a change is made**

## 3.4. Phase View

The Phase View is used to display and edit Traffic Signal Phases used in LinSig's Signal Controller Model. It is opened by choosing 'Phase View' from the LinSig Phase menu. The Phase View is used slightly differently depending on whether multiple stage streams are enabled with LinSig.

### 3.4.1. Single Stage Stream Use

The Phase View shows the current layout of Phases defined in the Controller. Each Phase is colour coded to indicate its phase type. Phases show directional arrows based on the Links they control and therefore arrows are only shown when a Phase controls one or more Links.



#### 3.4.1.1. Using the Phase View

The Phase View can be zoomed and panned as described above in 'General View Features'. This section also describes how to change other visual settings, how to print the Phase View and how to export its layout to other graphics software.

The Phase View shows the following:

- Each Phase is displayed as an arrow indicating the traffic movements controlled by the Phase.
- Phases are colour coded depending on Phase type.
- Phases can be moved by dragging the circular handles at each end of a Phase. The currently selected Phase will be indicated by the Phase Handles being highlighted red.
- Directional arrows are shown on the Phase only after one or more Links have been defined as being controlled by the Phase. It should be remembered that Phases may control several Links and that Links may be controlled by more than one Phase so that there will not always be a one-to-one correspondence between the arrows shown on Phases and Links. For example Phase A in the diagram above is a Three Aspect Phase controlling both ahead and right turn Lanes – hence it shows both

ahead and right turn arrows. Phase E is an Indicative Right Turn Arrow controlling just the right turn and shows only the right turn arrow.

### 3.4.1.2. Creating New Phases

A new Phase can be created as follows:

- Choose 'Add Phase...' from the Phase Menu or right click in the Phase View with the mouse and choose 'Add Phase...' from the pop-up menu.
- A new Phase is created and can be dropped in an appropriate position using the mouse.
- The Edit Phase Dialog box is shown and can be used to configure the Phase's properties as described below in 'Editing Phases'.
- The Phase can be repositioned if necessary by dragging the circular handles at each end of the Phase with the mouse.

### 3.4.1.3. Editing Phases

Phases can be edited by selecting the phase and choosing 'Edit Phase...' from the Phase Menu, or by double clicking with the mouse. The Edit Phase Dialog Box shown below is used to edit the Phases settings.

The 'Edit Phase' dialog box contains the following fields and controls:

- Phase:** A dropdown menu currently set to 'E'.
- Phase Type:** A dropdown menu currently set to 'Indicative Arrow'.
- Phase Type cannot be changed as the following links are controlled by this phase:** A text label next to a small box containing '1/2'.
- Associated Phase:** A dropdown menu currently set to 'A'.
- Street Min:** A text box containing the number '4'.
- Phase Name additional text:** An empty text box.
- Buttons:** 'OK' and 'Cancel' buttons at the bottom.

A Phase has the following parameters:

- **Phase Letter.** The letter used to reference the Phase in the Controller. The Phase can be relabelled by changing the Phase letter in the drop down List. Other Phases will be renumbered accordingly. Phases must be contiguous with no gaps in the Phase sequence.

- **Phase Type.** A phase can exist as one of eight different types. These are:
  - **Three Aspect Traffic Phase.** This is a 'standard' phase used for most normal traffic movements. Although the signals will in reality show periods of amber and red/amber LinSig models the signals as green or not green.
  - **Indicative Arrow Phase.** Generally used to provide an unopposed period for right turning traffic which turns in gaps in the opposing traffic for part of its cycle. IGA phases are often mistakenly called 'Right Filters'. True Right Filters are relatively uncommon in the UK.
  - **Filter Phase.** Usually used to control left turning traffic which starts before the main movement. Also very infrequently used to control right turning traffic as a true Right Filter.
  - **Pedestrian Phase.** Used to control Pedestrians. Again LinSig models the signals as green or not-green with any blackout periods being subsumed into the not-green period.
  - **Dummy Phase.** Dummy Phases are phases which exist only in the signal controller's software and do not control any lights or other equipment.
  - **Dummy with Red/Amber.** The same as a Dummy Phase but operates as though the Phase has a dummy Red/Amber period.
  - **Cycle Phase.** Identical to a Traffic Phase but with a green lamp with a cycle symbol.
  - **Bus Phase.** Identical to a Traffic Phase but with a green lamp with a bus symbol.
  - **LRT (Tram) Phase.** Same as a Traffic Phase but with no starting red/amber period and controls LRT signals rather than normal traffic signal lights.
  - **Filter with Closing Amber.** This Phase type is for use in the Republic of Ireland and other locations which allow similar signalling. This Phase should not be used in the UK as its behaviour does not conform to the Traffic Signs Regulations. The Filter Phase can be set as a Link's Arrow Phase but may start and end independently of the Link's Full Green Phase due to its Closing Amber, and therefore does not require an associated Phase. The Link will run if either its Filter or Full Green Phase is at Green. This type of Phase is usually configured in the Controller as a normal Three Aspect Phase.
- **Controlled Links.** If the Phase controls any Links the phase type cannot be altered. LinSig shows the controlled links which must be disconnected from this phase before the phase type can be altered.
- **Associated Phase.** If this Phase is a Filter or Indicative Green Arrow enter the associated Three Aspect Phase. If the Associated Phase does not yet exist you will need to return to this phase, after creating the associated phase, to enter the associated phase.
- **Phase Minimum.** Enter the Phase Minimum value. This value may be either a Street Minimum or a Controller Minimum depending on the Phase Minimum type setting in the Controller Settings. More detailed information on Phase minimums is located in the Controller Background Section.
- **Phase Name Additional Text.** Phase names are generated automatically by LinSig. To provide more flexibility in naming Phases you may enter some additional text that

will be appended to the generated Phase name. This is particularly important for pedestrian Phases as LinSig cannot usually generate a detailed phase name for a pedestrian phase. This is because Pedestrian Phases are not connected to Arms and therefore the Phase has no information regarding its location.

#### 3.4.1.4. Using a Phase to Control Links

Each Traffic Phase may control one or more Traffic Links. A Traffic Phase will display directional arrows in the Phase View based on the turning movements allowed on the Links it controls. No arrows will be shown if the Phase does not control any Links. The Phases controlling each Link are specified whilst editing Links in the Junction Layout View.

#### 3.4.1.5. Deleting Phases

To delete a Phase select it with the mouse and choose 'Delete Phase' from the Phase Menu, or right click on the Phase with the mouse and choose 'Delete Phase' from the pop-up menu. Any Intergreens or Phase Delays which are dependent on the Phase will also be deleted.

### 3.4.2. Using Multiple Stage Streams with the Phase View

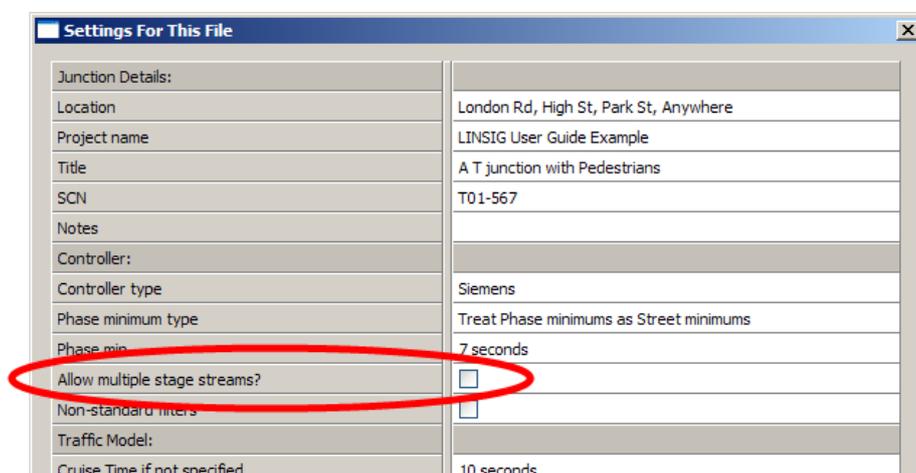
Multiple Parallel Stage Streams are a feature of traffic signal controllers which allow more than one junction, or independent parts of a single Junction, to be operated in parallel by a single traffic signal controller. As it is used in only a proportion of junction designs LinSig allows the feature to be switched off simplifying the interface. By default Multiple Stage Streams are switched off.

Every valid LinSig model must contain at least one Stage Stream. The maximum number of Stage Streams allowed depends on the controller type being used but is typically in the range four to eight with some newer controllers potentially allowing more. Remember that using multiple Stage Streams is usually associated with complex designs and the stream structure requires careful thought.

#### 3.4.2.1. Switching on Multiple Stage Streams

Multiple Stage Streams are switched on as follows:

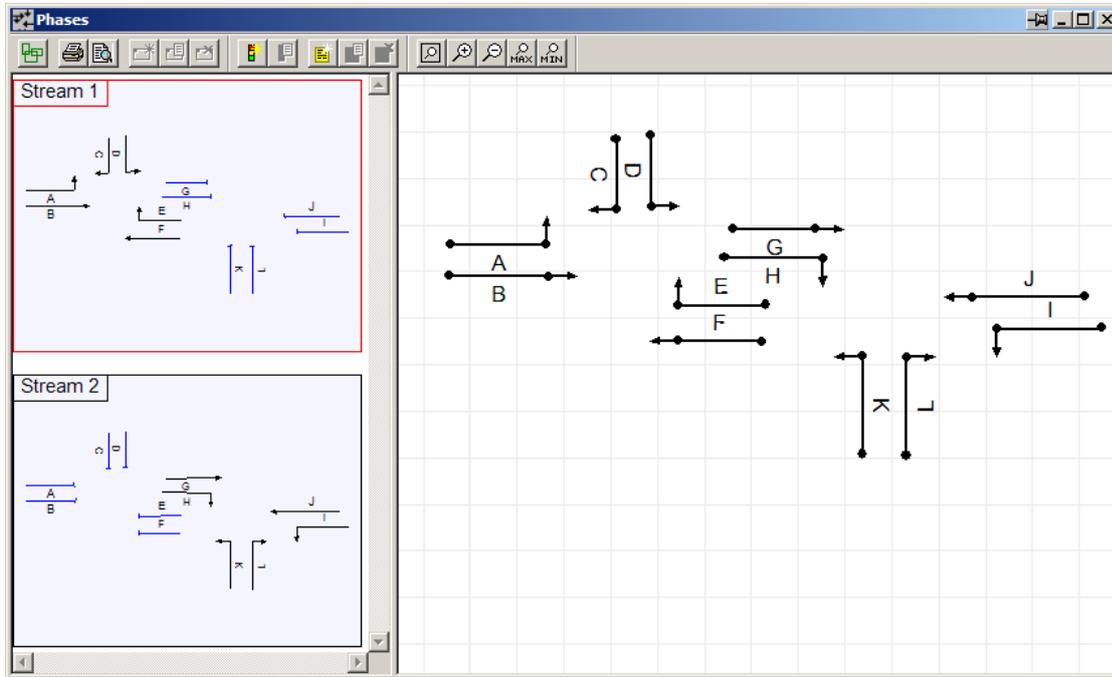
- Choose 'Show Controller Information' from the Junction Menu. This opens the File Settings Dialog Box which includes Controller Settings.
- In the Controller section tick 'Allow Multiple Stage Streams' and click OK to close the File Settings Dialog Box.



The Phase View will now be displayed as shown in the figure below.

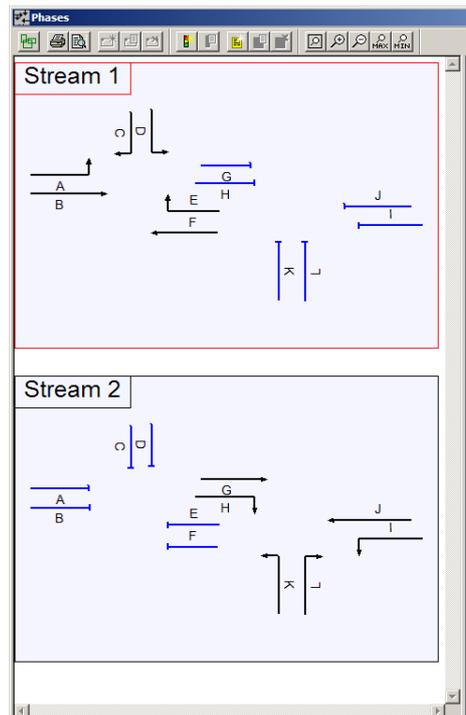
### 3.4.2.2. The Multiple Stage Stream Phase View

When Multiple Stage Streams are switched on the Phase View displays an additional panel to the left of the main Phase layout showing Stage Streams and the Phases allocated to each Stage Stream. This panel is similar to that shown in the Stage View when multiple Stage Streams are in use. The Stage Stream panel of either View can be used to add and delete Stage Streams and to allocate Phases to Streams.



### 3.4.2.3. The Stage Stream Panel

Each Stage Stream shows a reduced size copy of the Phase layout on the Controller. Phases are colour coded to show whether they are allocated to the current Stage Stream, are unallocated or allocated to a different Stage Stream.



Phases are displayed as follows:

- Phases allocated to a Stage Stream are shown in black and have directional arrows.
- Phases not allocated to any Stage Stream are shown in grey with no arrows.
- Phases allocated to a different Stage Stream are shown in blue with no arrows.

When more than one Stage Stream is defined:

- The set of Phases defined for the Controller are shared across all the Stage Streams.
- Each Phase can only be allocated to a single stage stream.
- A Phase can only run in a Stage in the Stage Stream to which it is allocated.
- A Phase cannot be removed from a Stage Stream if it is running in a Stage in that Stream.

It is recommended to allocate Phases to Stage Streams as soon as possible in the design as this will assist LinSig with error checking when working in other Views, particularly when defining which Phases run in which Stages in the Stage View.

#### **3.4.2.4. Selecting Stage Streams and the Current Stage Stream**

When carrying out an action on a Stream LinSig needs to know which Stream to use. The Stage Stream panel allows a Stage Stream to be selected, highlighting it in red. This selected Stage Stream will be used in all situations where an action is performed on a Stage Stream, for example when adding a Stage in the Stage View it will be added to the Current Stage Stream. The current Stage Stream can also be set using the Stage Stream dropdown list on the main LinSig toolbar.

#### **3.4.2.5. Creating a new Stage Stream**

To create a new Stage Stream choose 'Add a Stage Stream...' from the Stages Menu. A new Stage Stream will be shown in the Stage Stream panel. This will initially have no Phases allocated to it.

#### **3.4.2.6. Deleting Stage Streams**

To delete a Stage Stream select the Stream you wish to delete and choose 'Delete Stage Stream' from the Stages Menu or right-click pop-up menu.

#### **3.4.2.7. Allocating Phases to a Stage Stream**

Phases are allocated to a Stage Stream (or de-allocated if already allocated) by double clicking with the mouse. If the Phase is already allocated to a different Stage Stream LinSig will not allow it to be allocated to another Stage Stream without first removing it from its current Stream.

### 3.5. Intergreen View

The Intergreen View is used to view and change Phase Intergreens in the LinSig Controller model. The View displays Intergreens as a matrix with the terminating Phase on the Rows and the starting Phase on the columns.

The screenshot shows a window titled "Intergreen Matrix" with a dropdown menu set to "All Streams". Below the menu is a 9x9 matrix with phases A through I on both the rows and columns. The cells contain numerical values or dashes, and are color-coded: black for diagonal cells, red for conflicting phases, and yellow for associated phases.

	A	B	C	D	E	F	G	H	I
A	-	-	-	5	-	5	-	-	10
B	-	-	8	5	3	8	-	-	8
C	-	5	-	-	-	-	5	-	-
D	5	5	-	-	5	-	-	5	-
E	-	7	-	5	-	5	-	-	10
F	14	14	-	-	14	-	-	-	-
G	-	-	6	-	-	-	-	-	-
H	-	-	-	7	-	-	-	-	-
I	7	7	-	-	7	-	-	-	-

The Intergreens represent the safe clearance interval in seconds between the time a phase terminates and the time another phase starts. Advice on calculating Intergreens can be obtained in the DfT Advisory Leaflet TAL 1/06.

#### 3.5.1.1. Displaying Intergreens for Individual Stage Streams

If multiple Stage Streams are enabled in the current LinSig model the Intergreen View can show the Intergreens just for Phases within a Stage Stream rather than for all Phases. This allows the Intergreen View to be more concise.

The dropdown list in the Intergreen View's toolbar can be used to choose a Stage Stream for which to display Intergreens or to choose the normal Intergreen View showing all Phases.

#### 3.5.1.2. Intergreen Error Checking

LinSig checks whether an Intergreen is appropriate for each phase-to-phase movement taking into account which Phases run together in Stages and other relationships between Phases such as Filters and their Associated Phases.



A cell containing a dash indicates that there is currently no conflict between the phase pairs. You should enter an Intergreen value if you wish to define the phases as conflicting, or leave the cell blank if the phases do not conflict. Remember that a Intergreen of zero is not the same as having no Intergreen.



A cell with a red background indicates that the phases currently run together in a stage and can therefore have no conflicting value. You cannot enter a value in this cell.



A cell with a light blue background indicates that the phases are currently associated and can therefore have no conflicting value. You cannot enter a value in this cell.



A cell with a green background indicates that the intergreen matrix is currently asymmetrical and it is probable that an intergreen is required in this cell. Note that it is unusual to have an intergreen from a filter phase to another phase. LinSig therefore does not indicate a symmetry problem in this case.



A cell with a yellow background indicates that the phases are both pedestrian types and therefore are unlikely to have a conflicting value. You may enter a value in this cell but are unlikely to need to do so.



A cell with a blue background indicates that the phases are in different Stage Streams. As LinSig does not allow intergreens between Phases in different Streams you cannot enter a value in this cell.

### **3.5.1.3. To Change an Intergreen**

To change an Intergreen click on the Intergreen Matrix cell you wish to change and enter the new value. The Intergreen will be updated when you move away from the cell.

### **3.5.1.4. To Delete an Intergreen**

To delete an Intergreen select the appropriate cell and delete the value using the delete key. The Intergreen will be updated when you move away from the cell.

Tip: Remember that a zero length Intergreen is NOT the same as having no Intergreen.

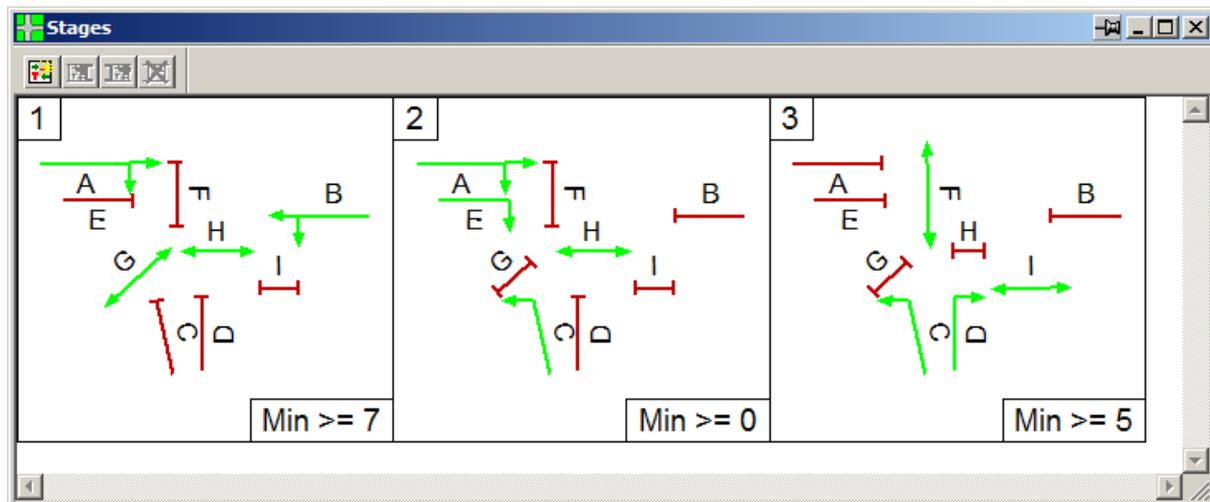
## 3.6. Stage View

The Stage View is used to create Traffic Signal Stages in the Controller model, and to display and edit the Phases running in each Stage. Each Stage represents a Stage configured in the controller and available for use in Staging Plans.

The Stage View is used slightly differently depending on whether multiple stage streams are enabled with LinSig.

### 3.6.1. Single Stage Stream Use

The Stage View displays each of the Stages in the single Stage Stream and shows which Phases run in each Stage.



#### 3.6.1.1. Using the Stage View

##### Phase Display

Phases are colour coded to indicate which are running and also to indicate any Phases which cannot be run for any reason. The layout of Phases in each Stage is provided by the Phase View so the position of Phases can be changed if necessary using the Phases View.

Phases are displayed as follows:

- **Green showing directional arrows** – The Phase runs in the Stage with the directional arrows indicating which movements the Phase controls.
- **Red with no Arrows** - The Phase cannot run in the Stage due to either a conflict with a Phase already running or with a phase delay already defined. The conflict is usually due to a Phase intergreen between this Phase and a Phase already running in the Stage. No arrows are shown indicating the phase is not running.
- **Blue with no Arrows** - The Phase cannot run in this stage as it would violate rules relating to the use of filter and indicative green arrow phases. No arrows are shown indicating that the phase is not running.
- **Grey with no Arrows** - The Phase could run in this stage but is not currently selected to do so. No arrows are shown indicating that the phase is not running.

##### Stage Minimums

LinSig can optionally show the minimum possible Stage Minimum for each Stage. In many cases Stages can run in a variety of orders and a Stage could have a different effective minimum for each possible Stage Sequence. LinSig therefore calculates Stage minimums

for all possible sequences of three stages and displays the lowest Stage Minimum found for the middle Stage. The minimum Stage Minimums are useful for specifying Stage Length limits in UTC or monitoring systems.

The Stage View shows only a summary of the minimum Stage Minimums. The Stage Minimum View shows more detail on how Stage Minimums vary for different Stage orders.

### **3.6.1.2. Selecting Stages and the Current Stage**

When carrying out an action on a Stage LinSig needs to know which Stage to use. The Stage View allows a Stage to be selected by clicking on it, the selected Stage being highlighted in red. This selected Stage will be used in all situations where an action is performed on a Stage, for example when deleting a Stage.

### **3.6.1.3. Creating a New Stage**

To create a new Stage choose 'Add Stage' from the Stages Menu or Right-Click at the end of the current Stages and choose 'Add Stage' from the pop-up menu. The Stage will be created with no Phases running.

### **3.6.1.4. Inserting a Stage**

To insert a Stage between two existing Stages select one of the Stages and choose 'Insert Stage before Selected Stage' or 'Insert Stage after Selected Stage' as appropriate from the Stages Menu. As Stages must always be in numerical order with no gaps in the sequence existing Stages will be renumbered when a Stage is inserted. Remember that the numerical order of Stages in the Controller does not imply that they must be run in this sequence in Staging Plans.

### **3.6.1.5. Renumbering a Stage**

To renumber a Stage, select it with the mouse and drag it to its new position in the Stage View. The other Stages in the Stream will be renumbered accordingly.

### **3.6.1.6. Deleting a Stage**

To Delete a Stage select it with the mouse and choose 'Delete Stage' from the Stages Menu or Right-Click on the Stage and choose 'Delete Stage' from the pop-up menu. The other Stages in the Stream will be renumbered to close the gap in the Stage order created by deleting the Stage.

Deleting a Stage has the following consequences:

- If the Stage is used in any Staging Plans it will be deleted from the Staging Plan.
- If any Phase Delays exist which are dependent on the Stage they will be deleted.

Tip: Remember that if you accidentally delete a Stage using Undo will completely restore any Staging Plans or Phase Delays affected by deleting the Stage.

### **3.6.1.7. Running or Removing a Phase from a Stage**

A Phase can be added to or removed from a Stage by double clicking with the mouse. This will add a non-running Phase to the Stage or remove a running Phase. A Phase which has a conflict with Phases already running or is subject to some other constraint cannot be run in the Stage and will be shown colour coded as described above to indicate why it cannot be

run. Double clicking on a Phase which cannot run will display more detail on the reason the Phase cannot run.

### 3.6.2. Using Multiple Stage Streams with the Stage View

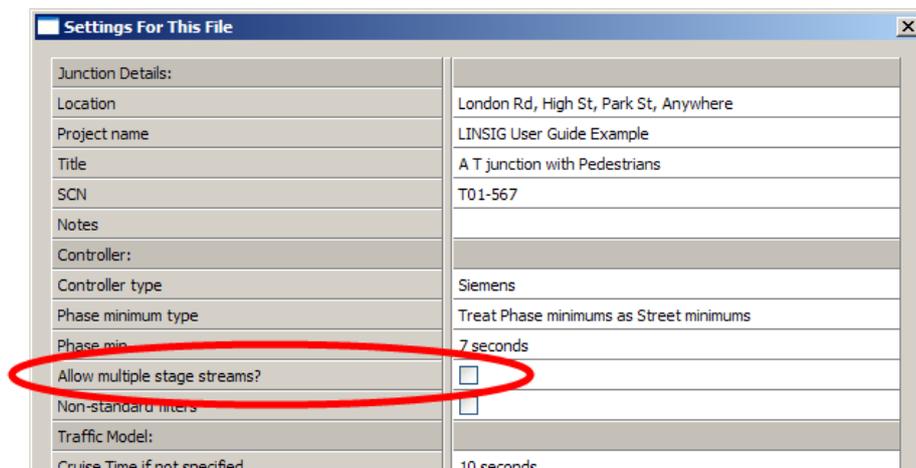
Multiple Parallel Stage Streams are a feature of traffic signal controllers which allow more than one junction, or independent parts of a single Junction, to be operated in parallel by a single traffic signal controller. As it is used in only a proportion of junction designs LinSig allows the feature to be switched off simplifying the interface. By default Multiple Stage Streams are switched off.

Every LinSig model must contain at least one Stage Stream. The maximum number of Stage Streams allowed depends on the controller type being used but is typically in the range four to eight with some newer controller potentially allowing more. Remember that using multiple Stage Streams is usually associated with complex designs and the stream structure requires careful thought.

#### 3.6.2.1. Switching on Multiple Stage Streams

Multiple Stage Streams are switched on as follows:

- Choose 'Show Controller Information' from the Junction Menu. This opens the File Settings Dialog Box which includes Controller Settings.
- In the Controller section tick 'Allow Multiple Stage Streams' and click OK to close the File Settings Dialog Box.

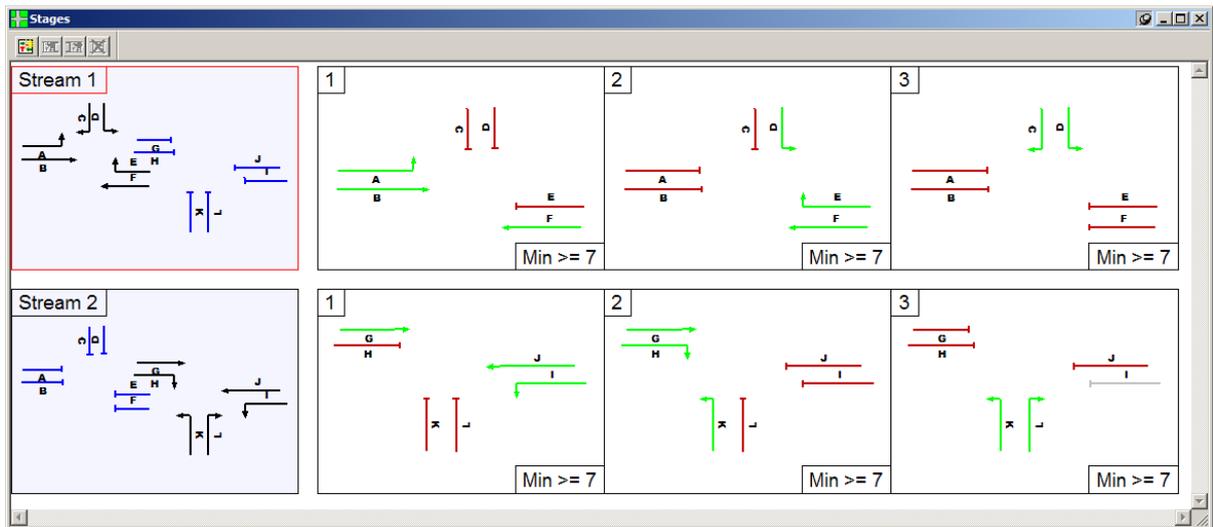


The Stage View will now be displayed as shown in the figure below.

#### 3.6.2.2. The Multiple Stage Stream Stage View

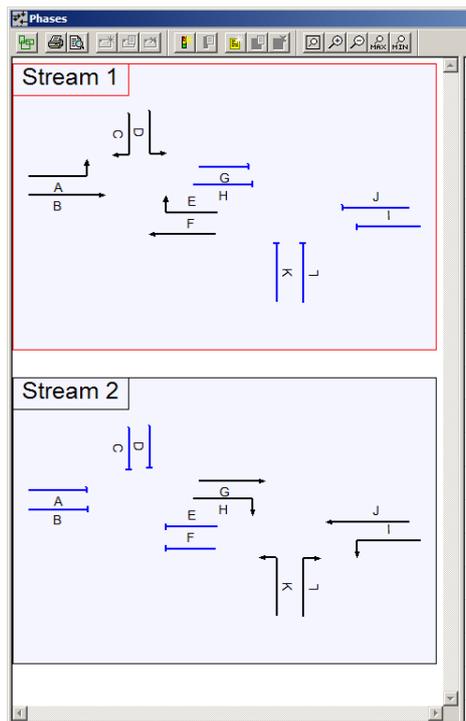
When Multiple Stage Streams are switched on the Stage View displays an additional panel to the left of the main Stage panel showing Stage Streams and the Phases allocated to each Stage Stream. This panel is similar to that shown in the Phase View when multiple Stage Streams are in use. The Stage Stream panel of either View can be used to add and delete Stage Streams and to allocate Phases to Streams.

With Multiple Stage Streams switched on LinSig allows a separate set of Stages to be defined for each Stream, with Stages in different Streams being made up of different sets of Phases.



### 3.6.2.3. The Stage Stream Panel

Each Stage Stream shows a reduced size copy of the Phase layout on the Controller. Phases are colour coded to show whether they are allocated to the current Stage Stream, are unallocated or allocated to a different Stage Stream.



Phases are displayed as follows:

- Phases allocated to a Stage Stream are shown in black and have directional arrows.
- Phases not allocated to any Stage Stream are shown in grey with no arrows.
- Phases allocated to a different Stage Stream are shown in blue with no arrows.

When Multiple Stage Streams are being used:

- The set of Phases defined for the Controller are shared across the Stage Streams.
- Each Phase can only be allocated to a single stage stream.
- A Phase can only run in a Stage in the Stage Stream to which it is allocated.

- A Phase cannot be removed from a Stage Stream if it is running in a Stage in that Stream.

It is recommended to allocate Phases to Stage Streams as soon as possible in the design as this will assist LinSig with error checking when working in other Views, particularly when defining which Phases run in which Stages in the Stage View.

### **Selecting Stage Streams and the Current Stage Stream**

When carrying out an action on a Stream LinSig needs to know which Stream to use. The Stage Stream panel allows a Stage Stream to be selected, highlighting it in red. This selected Stage Stream will be used in all situations where an action is performed on a Stage Stream, for example when adding a Stage in the Stage View it will be added to the Current Stage Stream.

### **Creating a new Stage Stream**

To create a new Stage Stream choose 'Add a Stage Stream...' from the Stages Menu. A new Stage Stream will be shown in the Stage Stream panel. This will initially have no Phases allocated to it.

### **Deleting Stage Streams**

To delete a Stage Stream select the Stream you wish to delete and choose 'Delete Stage Stream' from the Stages Menu or right-click pop-up menu.

### **Allocating Phases to a Stage Stream**

Phases are allocated to a Stage Stream (or de-allocated if already allocated) by double clicking with the mouse. If the Phase is already allocated to a different Stage Stream LinSig will not allow it to be allocated to another Stage Stream without first removing it from its current Stream.

### **3.6.2.4. Working with the Multiple Stage Stream Stage View**

Stages can be created, deleted, renumbered and their Phases changed in an almost identical manner as the single Stream View. The main differences are:

- Each Stream has a separate set of Stages and inserting or deleting Stages in one Stream does not affect the Stages in another Stream.
- Each Stage box shows only the Phases allocated to the Stream to which the Stage belongs. The stage boxes can be set to scale to fit to all Phases or just the Phases in the Stream by clicking the 'Toggle Fitting of Stage Display to Stream' button on the Stage View's toolbar.

## 3.7. Staging Plan View

A LinSig Staging Plan consists of a Sequence of Stages for each Stage Stream. Stages can run in any order in a Staging Plan and if necessary can run more than once or not at all. This differs from the Stage View which shows the Stages in the order they are configured in the Controller. For example, typical Staging Plans may include Plans such as 'All Stages', 'Early Cut Off', and 'Including Pedestrian All Red'.

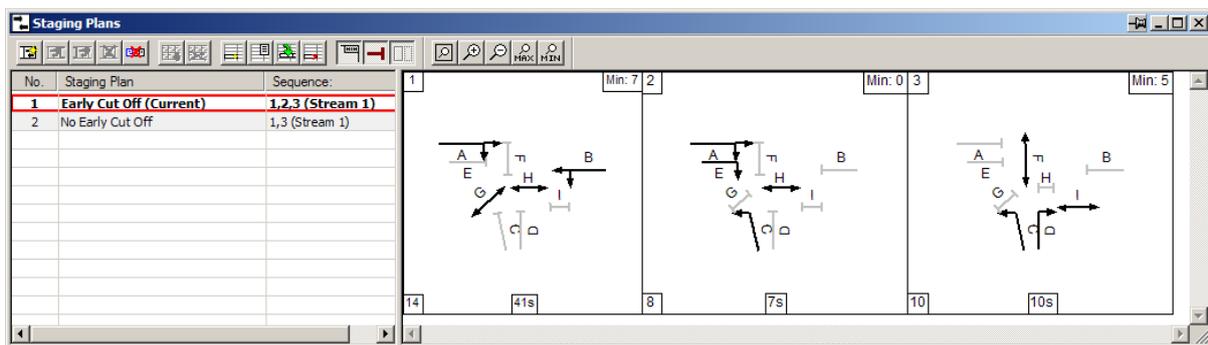
The Staging Plan View is used to create and edit Staging Plans, and to display and edit the Stages running in each Plan. The View is opened by choosing 'Staging Plan View' from the Staging Plans Menu.

The Staging Plan View is used slightly differently depending on whether multiple stage streams are enabled with LinSig.

### 3.7.1. Single Stage Stream Use

The Staging Plan View is comprised of two panels:

- The Staging Plan List down the left hand side of the View lists all the stored Staging Plans for the LinSig model.
- The Staging Plan Stage Sequence Panel shows the sequence of Stages making up the currently selected Staging plan and also displays timing information for the plan such as Stage durations and minimums.



#### 3.7.1.1. The Staging Plan List

The Staging Plan List lists all of the Staging Plans currently defined in the LinSig model. The following information is shown for each Staging Plan:

- **The Staging Plan Number.** A unique reference number for each Staging Plan.
- **The Staging Plan Name.** A name for the Staging Plan.
- **Sequence.** The Stage Sequence for the Staging Plan.
- **The Selected Staging Plan.** The Selected Staging Plan is highlighted in red. The Selected Staging Plan is the Staging Plan which is shown and edited in the other panel of the Staging Plan View. It is not necessarily the Staging Plan being used for model calculations. The Selected Staging Plan can be changed by clicking a Staging Plan in the Staging Plan List.
- **The Current Scenario Staging Plan.** The Staging Plan currently being used for model calculations is inferred by the current Scenario selected in the Scenario View and is shown in bold and labelled '(current Scenario)' in the Staging Plan List. It is changed by selecting a new Current Scenario in the Scenario View. When the

Current Scenario is changed LinSig will recalculate model results using the Staging Plan and other settings from the new Current Scenario.

### **Creating a New Staging Plan**

A new Staging Plan can be created by choosing 'Create Staging Plan' from the Staging Plans Menu or by right-clicking on the Staging Plan List and choosing 'Create Staging Plan' from the pop-up menu. The Staging Plan will be created with a default name but with an empty Stage Sequence.

### **Editing a Staging Plan**

A Staging Plan can be edited by selecting it in the Staging Plan List and choosing 'Edit Staging Plan' from the Staging Plans menu. This will open the Edit Staging Plan dialog box which can be used to renumber the Staging Plan and to change its name. Alternatively the Staging Plan Name can be edited directly by clicking on a Plan name in the Staging Plan List.

### **Deleting a Staging Plan**

A Staging Plan can be deleted by selecting the Staging Plan in the Staging Plan List and choosing 'Delete Staging Plan' from the Staging Plans Menu. After deleting a Staging Plan the next Plan is automatically selected. When a Staging Plan which is currently used in one or more Scenarios is deleted the Scenarios using the deleted Staging Plan will become invalid and will require a new Staging Plan to be set in the Scenario View before they can be used again.

#### **3.7.1.2. The Staging Plan Stage Sequence**

The Staging Plan Stage Sequence shows the Sequence of Stages configured for the current Staging Plan. Stages can run in any order and can if necessary be repeated.

The Stage Sequence shows a Stage diagram for each time a Stage runs in the Stage Sequence. Each Stage diagram shows the Phases running in the Stage and other information about the Stage. This includes:

- The Phases running in the Stage are shown in black and the Phases not running in light grey.
- The Interstage duration between a Stage and its preceding Stage is shown in the bottom-left corner of the Stage. This is only shown for the Staging Plan associated with the Current Scenario as other Staging Plans do not store signal timings.
- The duration of the Stage in this Staging Plan is shown in the bottom-centre of the Stage. This is for display only – the Stage duration can be changed in the Signal Timings View. This is only shown for the Staging Plan associated with the Current Scenario as other Staging Plans do not store signal timings.
- The Stage Minimum of the Stage is shown in the top-right corner of the Stage. The Stage Minimum shown is the particular Minimum for the Sequence of Stages in the Staging Plan. Other Sequences of Stages may result in different Stage Minimums. See the Stage Minimums View for more information.

Some of the above data items are only available when the Stage Sequence is valid. If the Sequence is invalid as described below some items may not be shown.

## Changing the Way the Stage Sequence is displayed

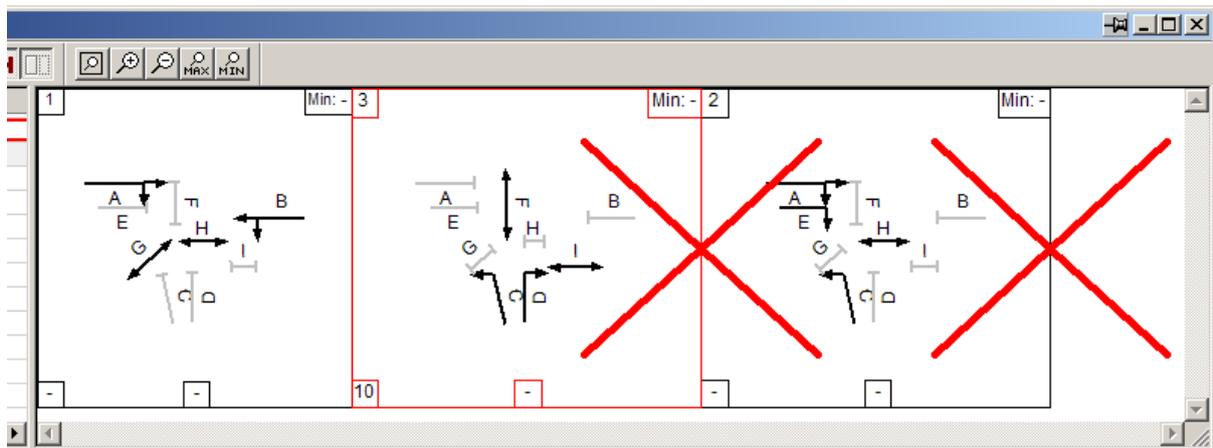
The Staging Plan View toolbar includes a number of buttons which control the way the Stage Sequence is displayed. Options include:

- Non-Running Phases can be omitted.
- The display of Stage durations, minimums and Interstages can be omitted.

## Stage Sequence Validation

LinSig checks Stage Sequences in Staging Plans to ensure they are valid. A Stage Sequence is valid if the sequence does not contain any Prohibited Stage Changes, all Stages containing filters or indicative arrows are terminated correctly, and no other problems exist in the sequence. An invalid Sequence is indicated in two ways. These are:

- A large red cross over a Stage Change. This indicates that the Stage Change has been prohibited. If you wish to use this Stage Change in a Stage Sequence first use the Prohibited Stage Changes View to investigate why the Stage Change is prohibited, and remove the prohibition if appropriate.
- A large blue cross over a stage change. This indicates that although the Stage Change has not been prohibited, it cannot take place due to a problem - typically a Filter or Indicative Arrow Phase is not being terminated correctly. If you wish to use this Stage Change in a Stage Sequence first use the Phase View and Interstage View to investigate the relationship between associated phases and amend as necessary to make the Stage Change legal.



As you build up a Stage Sequence the unfinished sequence will usually show a number of sequence errors. This is quite normal and reflects the fact that the Stage Sequence is not valid until it is complete.

All of the traffic model calculations in LinSig depend on the Staging Plan associated with the Current Scenario containing a valid Stage Sequence. If a valid stage Sequence is not defined many of the results views will be unable to show any results. In this case error messages are shown indicating the possible cause of the problem. As soon as a Scenario with a valid Staging Plan is selected or the current Scenario's associated Staging Plan's Stage Sequence is changed to define a valid Stage Sequence the result Views will be automatically refreshed with results for the new or corrected current Staging Plan.



Sequence LinSig will update the model calculations for Scenarios using the changed Staging Plan.

### Removing a Stage from the Stage Sequence

A Stage can be removed from the Stage Sequence by selecting it with the mouse and choosing 'Remove Selected Stage from Staging Plan' from the Staging Plan menu, or by right clicking on the Stage and choosing 'Remove Selected Stage from Staging Plan' from the pop-up menu. Removing a Stage from a Staging Plan does not delete the Stage itself.

### 3.7.2. Using Multiple Stage Streams with the Staging Plan View

Multiple Parallel Stage Streams are a feature of traffic signal controllers which allow more than one junction, or independent parts of a single Junction, to be operated in parallel by a single traffic signal controller. As it is used in only a proportion of junction designs LinSig allows the feature to be switched off simplifying the interface. By default Multiple Stage Streams are switched off.

Every LinSig model must contain at least one Stage Stream. The maximum number of Stage Streams allowed depends on the controller type being used but is typically in the range four to eight with some newer controllers potentially allowing more. Remember that using multiple Stage Streams is usually associated with complex designs and the stream structure requires careful thought.

#### 3.7.2.1. Switching on Multiple Stage Streams

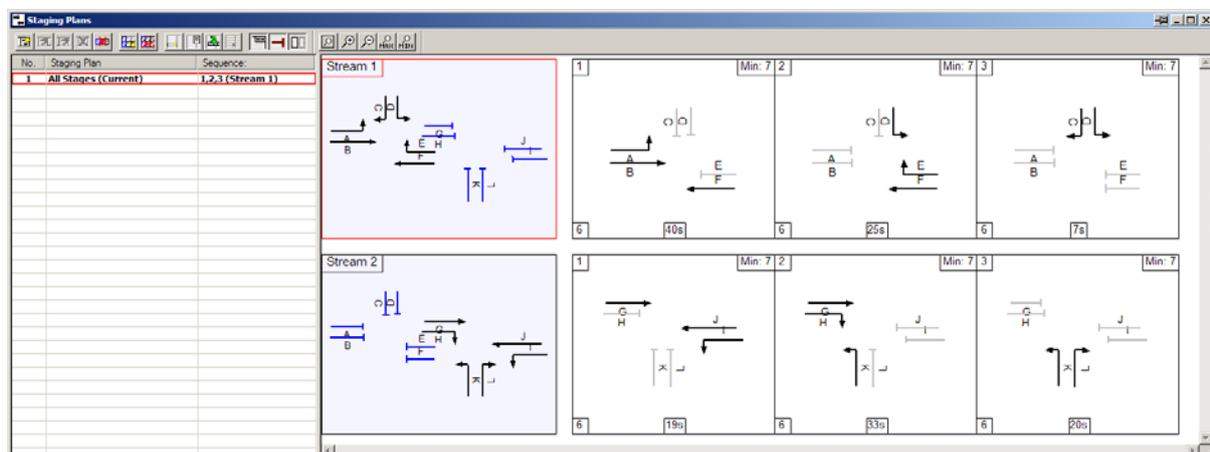
Multiple Stage Streams are switched on as follows:

- Choose 'Show Controller Information' from the Junction Menu. This opens the File Settings Dialog Box which includes Controller Settings.
- In the Controller section tick 'Allow Multiple Stage Streams' and click OK to close the File Settings Dialog Box.

The Staging Plan View will now be displayed as shown in the figure below.

#### 3.7.2.2. The Multiple Stage Stream Staging Plan View

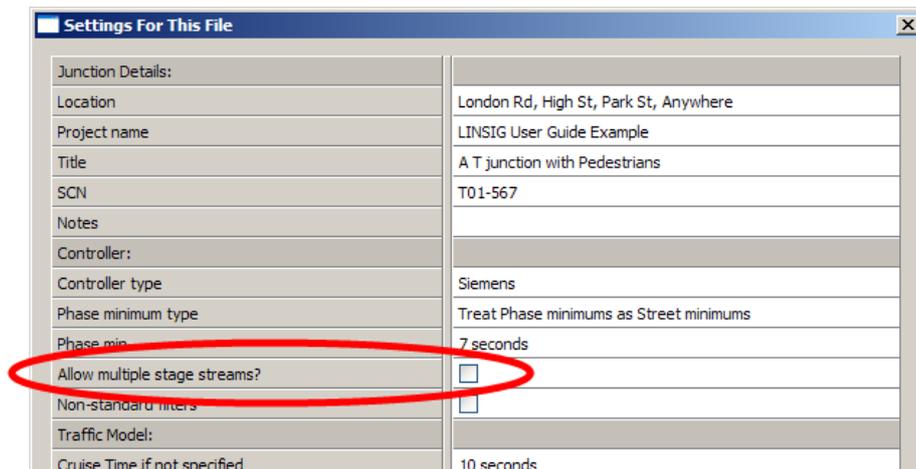
When Multiple Stage Streams are switched on the Staging Plan View displays an additional panel to the left of the main Stage Sequence panel showing Stage Streams and the Phases allocated to each Stage Stream. This panel is similar to that shown in the Phase View and Stage View when multiple Stage Streams are in use, however the Staging Plan View's Stage Stream display cannot be used to change the Phases allocated to the Stage Stream.



With Multiple Stage Streams switched on LinSig requires a separate Stage Sequence to be defined for each Stage Stream. The Stage Sequence for each Stream is made up of Stages defined for that Stage Stream. Stages defined for a Stage Stream cannot be used in the Stage Sequences of different Stage Streams.

### 3.7.2.3. The Stage Stream Panel

Each Stage Stream shows a reduced size copy of the Phase layout on the Controller. Phases are colour coded to show whether they are allocated to the current Stage Stream, are unallocated or allocated to a different Stage Stream.



Phases are displayed as follows:

- Phases allocated to a Stage Stream are shown in black and have directional arrows.
- Phases not allocated to any Stage Stream are shown in grey with no arrows.
- Phases allocated to a different Stage Stream are shown in blue with no arrows.

The Stage Stream Panel in the Staging Plan View cannot be used to change the Stage Stream.

### Selecting Stage Streams and the Current Stage Stream

When carrying out an action on a Stream LinSig needs to know which Stream to use. The Stage Stream panel allows a Stage Stream to be selected, highlighting it in red. This selected Stage Stream will be used in all situations where an action is performed on a Stage Stream, for example when adding a Stage to a Stage Sequence in the Staging Plan View it will be added to the end of the Stage Sequence for the current Stage Stream. The current Stage Stream can also be set using the drop down list in the main toolbar.

### 3.7.2.4. Working with the Multiple Stage Stream Staging Plan View

Staging Plans are created and edited for multiple Stage Stream models in an almost identical manner to single Stage Stream models as described above. The main differences are:

- Each Staging Plan requires a Stage Sequence to be defined for each Stage Stream. Each Stage Sequence is created and edited in the same manner as single Stage Stream Stage Sequences.
- When viewing or entering a Stage Sequence in the 'Sequence' column of the Staging Plan List the current Stream is viewed or edited. To view or edit the Stage Sequence for a different Stage Stream change the current Stage Stream as described above before making changes the same as in the single Stream case described above.

- When adding Stages to a Stage Sequence they will be added to the end of the Sequence for the currently selected Stream.
- When inserting Stages into a Stage Sequence the new Stage will be inserted into the same sequence as the currently selected Stage.
- When dragging Stages from the Stage view they can only be dropped into the same Stream's Stage Sequence in the Staging Plan View.
- An Invalid Stage Sequence for any Stream will prevent LinSig from calculating traffic model results.

### 3.8. Scenario View

The Scenario View allows Traffic Flow Groups and Staging Plans to be associated together to define particular modelling scenarios. Each Scenario brings together all the information needed for a single LinSig run. This includes:

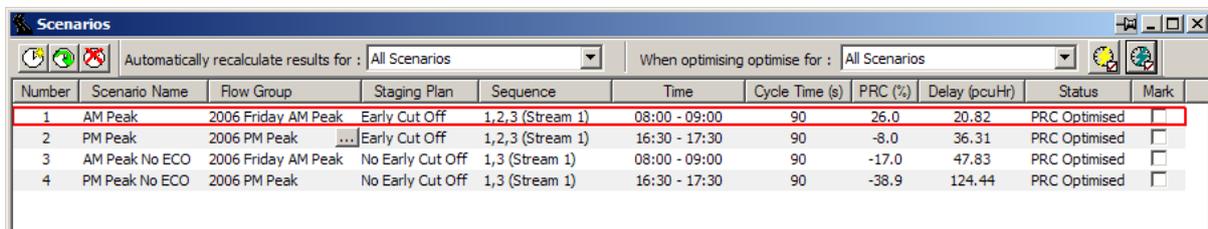
- **Traffic Flow Group**
- **Staging Plan**
- **Cycle Time**
- **Signal Stage Times**

Typically a number of Scenarios will be set up with each Scenario representing a different combination of the above information for which LinSig model results are required. Using Scenarios makes changing between different model runs very easy as the current Scenario can simply be changed rather than having to remember to change each of the above individual settings.

**Note for users of LinSig prior to Version 2.4.** Prior to LinSig V2.4 signal times were stored in the Signal Plan rather than the Scenario. This meant that each Scenario required a different Signal Plan to be defined to enable different green times to be used for each Scenario. This could be tedious when many Scenarios were used. Version 2.4 removes this problem by moving the signal time information from the Signal Plans to the Scenarios. Signal Plans are renamed Staging Plans to reflect this. This means that each Scenario automatically contains its own cycle time set of green times avoiding the need to have many Signal Plans. Staging Plans now can be shared between a number of Scenarios reducing their complexity considerably. It may be beneficial to review the Staging Plans in any models created in versions of LinSig prior to V2.4 as they can often be simplified considerably.

#### 3.8.1. Working with Scenarios

The Scenario View is used to create, select, edit and delete Scenarios. It can be opened by choosing 'Scenario View' from the Scenario Menu.



Number	Scenario Name	Flow Group	Staging Plan	Sequence	Time	Cycle Time (s)	PRC (%)	Delay (pcuHr)	Status	Mark
1	AM Peak	2006 Friday AM Peak	Early Cut Off	1,2,3 (Stream 1)	08:00 - 09:00	90	26.0	20.82	PRC Optimised	<input type="checkbox"/>
2	PM Peak	2006 PM Peak	Early Cut Off	1,2,3 (Stream 1)	16:30 - 17:30	90	-8.0	36.31	PRC Optimised	<input type="checkbox"/>
3	AM Peak No ECO	2006 Friday AM Peak	No Early Cut Off	1,3 (Stream 1)	08:00 - 09:00	90	-17.0	47.83	PRC Optimised	<input type="checkbox"/>
4	PM Peak No ECO	2006 PM Peak	No Early Cut Off	1,3 (Stream 1)	16:30 - 17:30	90	-38.9	124.44	PRC Optimised	<input type="checkbox"/>

The Scenario View lists all the Scenarios displaying the following for each Scenario:

- **The Scenario Name.** This should be a descriptive name for the Scenario. For example 'AM Peak with Right Turn Stage'.
- **The Scenario Flow Group.** The Traffic Flow Group used by the Scenario.
- **The Scenario Staging Plan.** The Staging Plan used by the Scenario.

- **The Scenario Stage Sequence.** The Stage Sequence is inherited from the Scenario's Staging Plan and is edited in the Staging Plan View. If multiple Stage Streams are being used only the Sequence of the selected Stage Stream is shown.
- **The Scenario Time Period.** The Time Period covered by the Scenario. This is inherited from the Scenario's Flow Group and is edited in the Traffic Flow Group View.
- **The Scenario Cycle Time.** The Cycle time used by this Scenario.
- **The Scenario Results Summary.** Summary results including the Practical Reserve Capacity (PRC) and Delay are shown for the Scenario. These are based on the Scenarios current signal times.
- **The Scenario Status.** Displays the status for the Scenario. This includes whether model results have been calculated since the last change to the model and whether the Scenarios green times have been optimised.
- **Mark.** Allows a Scenario to be selected as requiring calculation or optimising when the Scenario View is set to only calculate or optimise selected Scenarios.

### 3.8.1.1. Creating a New Scenario

To create a new Scenario choose 'New Scenario' from the Scenarios Menu or click the 'New Scenario' button in the Scenario View's toolbar. This creates a new Scenario with a default name, a default Flow Group and Staging Plan, and arbitrary signal times.

The Scenario Name, Flow Group or Staging Plan can be changed by clicking on the item you wish to change in the Scenario View and entering a new name or choosing a new setting from the resulting drop down list.

Scenarios can also be copied by selecting a Scenario and choosing 'Copy this Scenario' from the Scenarios menu.

### 3.8.1.2. Editing a Scenario

A Scenario's Name, Flow Group or Staging Plan can be changed by clicking on the item you wish to change in the Scenario View and entering a new name or choosing a new setting from the resulting drop down list. The Scenario Time Period cannot be changed as it is inherited from the Scenario's Flow Group. If necessary the time period can be changed in the Traffic Flows View. The Scenario's cycle time and signal settings are changed by selecting the Scenario as described below and changing settings in the other Views.

### 3.8.1.3. Deleting a Scenario

A Scenario can be deleted by selecting the Scenario and choosing 'Delete Scenario' from the Scenarios Menu. Deleting a Scenario does not delete the Scenario's associated Flow Group or Staging Plan.

### 3.8.1.4. Selecting a Scenario for Editing

A Scenario can be selected for editing either by:

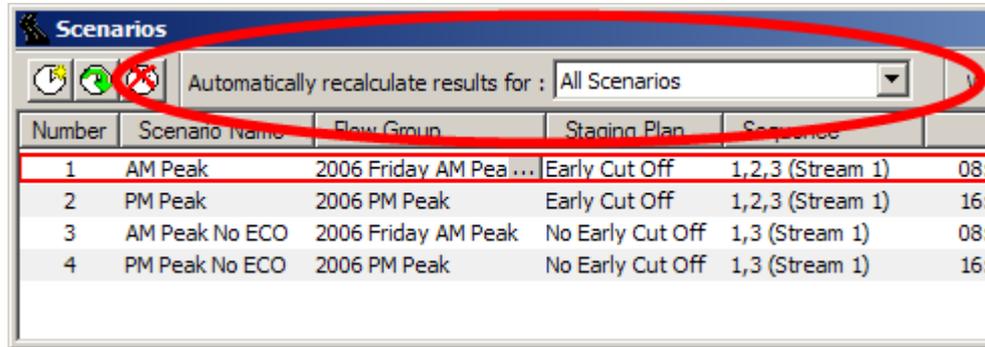
- Clicking on the Scenario in the Scenario View. The selected Scenario will be shown highlighted in red.
- Choosing a new current Scenario from the drop down list in the LinSig main toolbar.

When a new Scenario is selected all other Views are updated to display, and allow editing of, information relating to the new Scenario. For example the Signal Timings View will always show the Stage green times relating to the currently selected Scenario.

### 3.8.1.5. Controlling Recalculation of Model Results

When an item of data affecting model results is changed, for example a Saturation Flow being altered, LinSig will need to recalculate model results for each Scenario affected. The Scenario View can be used to control when this recalculation takes place.

Recalculation is controlled using the 'Automatically Recalculate Results for:' drop down list in the Scenario View's toolbar.



The options available are:

- **Automatically Recalculate Results for all Scenarios.** LinSig will immediately recalculate results for all Scenarios listed in the Scenarios View when model input data changes. This should be the normal setting and should only be changed if a large number of Scenarios, or a large modelled Network, is causing unacceptably long recalculation times.
- **Automatically Recalculate Results for Current and Marked Scenarios.** LinSig will immediately recalculate results for the current Scenario and any Scenarios with the 'Mark' column in the Scenarios View ticked. This allows recalculation of any superseded or redundant Scenarios to be avoided. Obviously results will not be displayed in the Scenarios View for any non-calculated Scenarios, which will show a status of 'Not Calculated' in the Status column. Selecting a Scenario as the Current Scenario will immediately recalculate model results for that Scenario.
- **Automatically Recalculate Results for Current Scenario only.** LinSig will immediately recalculate results for the current Scenario. All other Scenarios will be given the Status 'Not Calculated' and will not show results in the Scenario View. This setting provides the quickest recalculation time but each Scenario will only be recalculated if it is selected as the Current Scenario.

Any Scenario which has been successfully recalculated since the last change to any input data affecting model results will show a status of 'calculated' in the Scenario View. If for any reason a Scenario cannot be recalculated a status of 'Error' will be displayed. The details of what may have caused the error can be found in the Error View.

### 3.8.1.6. Controlling Batch Signal Time Optimisation in the Scenario View

The Scenario View can be used to optimise signal times for a number of Scenarios at once. This avoids having to optimise each Scenario individually by selecting each Scenario in turn before clicking the 'Optimise' button on the main toolbar. If desired each Scenario can still be optimised individually using 'Optimise Current Scenario for Delay/PRC' on the Optimiser menu.

The batch optimisation in the Scenario View is controlled using the 'When optimising optimise for:' drop down list in the Scenario View's toolbar.

Number	Scenario Name	Flow Group	Staging Plan	Sequence	Time	Cycle Time (s)	PRC (%)	Delay (ppuHd)	Status	Mark
1	AM Peak	2006 Friday AM Peak	Early Cut Off	1,2,3 (Stream 1)	08:00 - 09:00	90	26.0	20.82	PRC Optimised	<input type="checkbox"/>
2	PM Peak	2006 PM Peak	Early Cut Off	1,2,3 (Stream 1)	16:30 - 17:30	90	-8.0	36.31	PRC Optimised	<input type="checkbox"/>
3	AM Peak No ECO	2006 Friday AM Peak	No Early Cut Off	1,3 (Stream 1)	08:00 - 09:00	90	-17.0	47.83	PRC Optimised	<input type="checkbox"/>
4	PM Peak No ECO	2006 PM Peak	No Early Cut Off	1,3 (Stream 1)	16:30 - 17:30	90	-38.9	124.44	PRC Optimised	<input type="checkbox"/>

The options available are:

- **Optimise All Scenarios.** When either the 'Optimise Scenarios for Delay' or 'Optimise Scenarios for PRC' button on the Scenario View's toolbar is clicked LinSig will optimise the signal times for all Scenarios. For complex models or large numbers of Scenarios this may take several seconds or even several minutes in extreme cases.
- **Optimise Current and Marked Scenarios.** When either of the optimise buttons on the Scenario View's toolbar are clicked LinSig will optimise the signal times for both the currently selected Scenario and any Scenarios ticked in the Scenario View's 'Marked' column. This allows a subset of Scenarios to be batch optimised which can be useful when optimising larger models or when a large number of Scenarios exist.
- **Optimise Current Scenario.** When either of the optimise buttons on the Scenario View's toolbar are clicked LinSig will optimise the signal times for the currently selected Scenario only. This is equivalent to choosing 'Optimise Current Scenario...' from the Optimiser menu.

Regardless of the above option chosen LinSig will give any optimised Scenario a status of either 'delay optimised or 'PRC Optimised' indicating the results shown are optimal. If any model data is changed which means one or more Scenarios may no longer be optimal LinSig will change their status to 'Calculated' reflecting the fact they need to be re-optimised.

### 3.9. Signal Timings View

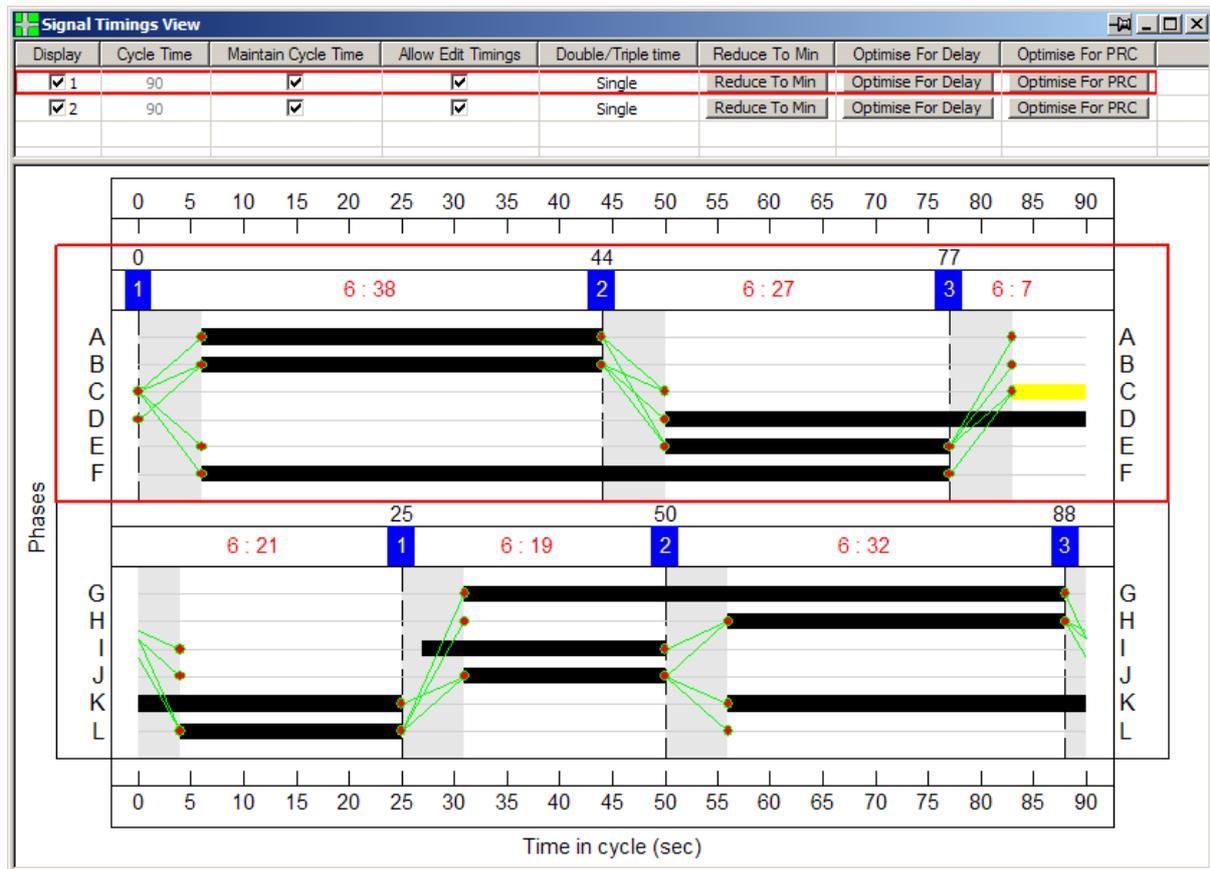
The Signal Timings View is used to view and adjust the Stage and Phase timings for the Current Scenario and its associated Staging Plan. The View is opened by choosing 'Signal Timings View' from the Staging Plans menu.

The Signal Timings View is used in a similar manner regardless of whether multiple stage streams are enabled with LinSig.

#### 3.9.1. Multiple & Single Stage Stream Use

The Signal Timings View is comprised of two panels:

- **The Stage Stream List.** This allows timing and display settings for each Stage Stream to be controlled. When Single Stage Streams are switched on a single line showing the only Stage Stream is displayed.
- **The Signal Timings Panel.** This shows the Stage and Phase Times for the current Scenario and its associated Staging Plan over the Network Cycle Time. A wide range of other information such as Intergreens are also shown as described below.



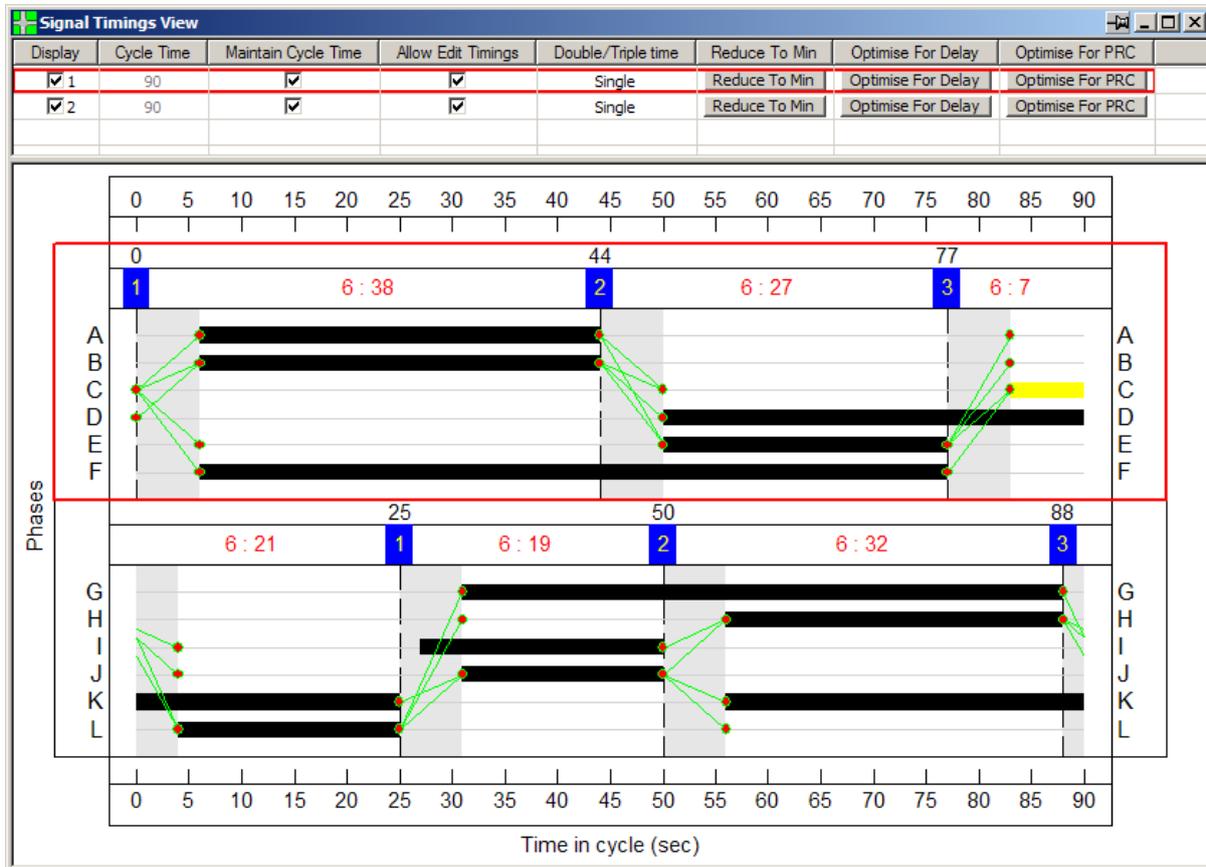
### 3.9.1.1. The Stage Stream List

The Stage Stream List allows the following options and settings to be controlled for the Stage Stream:

- **Display.** This controls whether the Signal Timings are shown for this Stage Stream. This is permanently on when Multiple Stage Streams are switched off.
- **Cycle Time.** This displays the current Cycle Time for a Stage Stream in the current Scenario. This will usually be the same as the Network Cycle Time set on the main toolbar. It may however be different from the Network Cycle Time when:
  - Constraints such as the Stage Stream's minimum Cycle Time would be violated if the Network Cycle Time was applied to the Stage Stream.
  - A Stage Sequence with a different Cycle Time to the Network Cycle Time has been created or imported into the Scenario.
- **Attempt to Maintain Cycle Time.** When 'Attempt to Maintain Cycle Time' is ticked LinSig will attempt to maintain the Stream's Cycle Time equal to the Network Cycle time when making changes to traffic signal related data in LinSig. For example, if an Intergreen is changed which lengthens an Interstage, LinSig will; if possible, reduce one of the Stage lengths to maintain the Cycle Time.
- **Allow Edit Timings.** When 'Allow Edit Timings' is un-ticked LinSig does not allow Stage Timings to be changed in the Stage. This is useful to prevent making inadvertent changes to signal timings.
- **Multi-cycling.** The Multi-Cycling setting provides a quick way of implementing simple equal length double and triple cycling. It allows a Stage Sequence to be repeated twice or three times within the Stream's overall Cycle Time. Each half or third cycle will be of equal length. This option is not suitable for implementing unequal length double cycling which should be implemented by repeating Stages in the Staging Plan.
- **Reduce to Minimum.** Click the 'Reduce to Minimum' button to reduce the Stage Streams Cycle Time to its minimum length. This will automatically untick 'Maintain Cycle Time' as the link with the Network Cycle Time is broken. The Network Cycle Time can be re-implemented by re-ticking 'Maintain Cycle Time'.
- **Optimise Delay.** Clicking the 'Optimise Delay' button optimises the Stage lengths for the Stage Stream to minimise aggregate delay for links controlled by the Stage Stream. All other Stage Streams are unchanged.
- **Optimise PRC.** Clicking the 'Optimise PRC' button optimises the Stage lengths for the Stage Stream to maximise Practical Reserve Capacity (PRC) for links controlled by the Stage Stream. All other Stage Streams are unchanged.

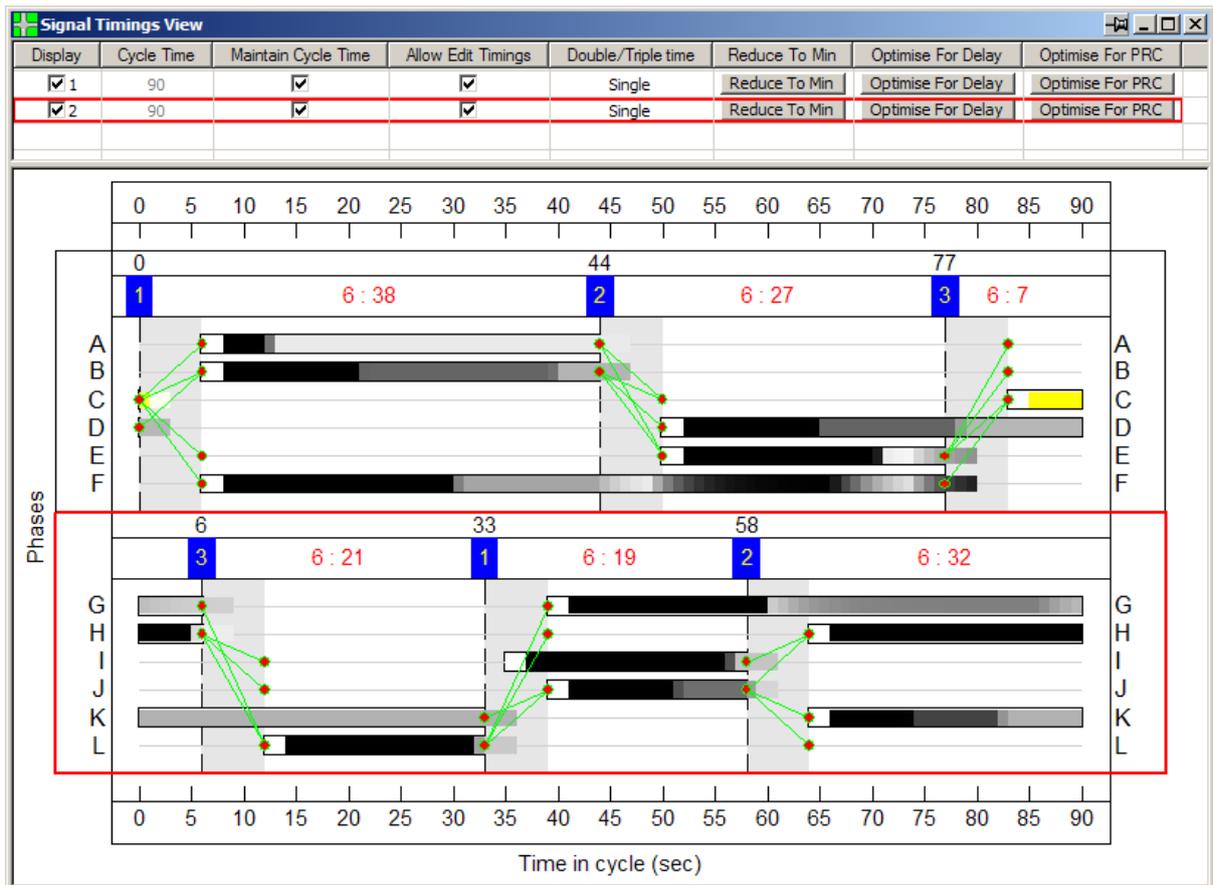
### 3.9.1.2. The Signal Timings Panel

The Signal Timings Panel is located below the Stage Stream List in the Signal Timings View. When a junction contains more than one Stage Stream a Signal Timings panel is displayed for each Stage Stream as shown below.



Each Signal Timings Panel shows the following:

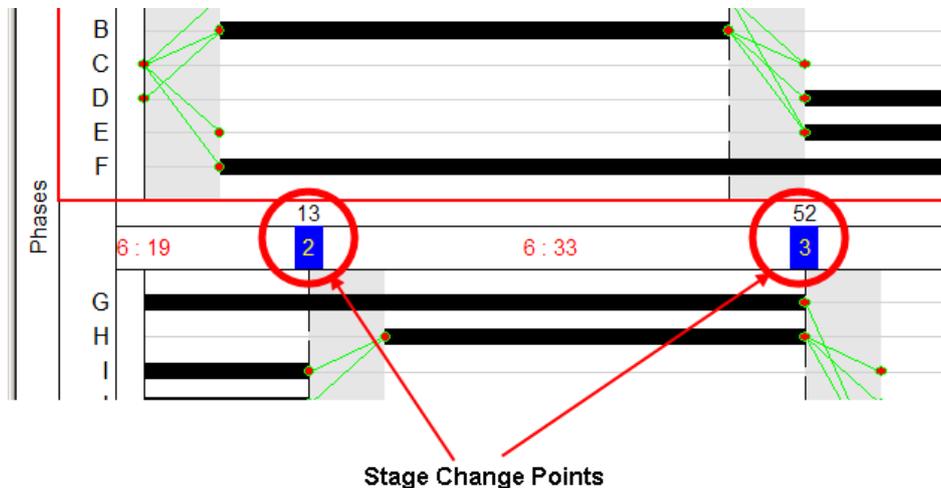
- **Phase Bars.** Each traffic signal Phase is represented as a bar showing the times when the Phase is running. Phase Bars are displayed as follows:
  - Coloured by Phase Type using the same colours as the Phase View.
  - Displayed in yellow if the Phase is running to minimum.
  - Displayed in red if abnormally the Phase Minimum is being violated. LinSig will normally prevent this but some obscure uncommon scenarios can cause a Phase Minimum to be violated. LinSig will also include an error message in the Error View and traffic model results will not be available.
  - Shaded by intensity of Outflow controlled by the Phase. Right Click on the Signal Timings Panel and choose 'Show Out Flow' to select this Phase bar display mode. LinSig will shade the Phase bar in proportion to the level of traffic flow crossing the stop line. If the most saturated link controlled by the Phase is at Saturation the Phase bar will be 100% shaded. If however no flow is crossing the stop line the Phase bar will be shown transparent. This display allows a rapid assessment to be made of the efficiency of green time use.



- **Stages.** Each Traffic Signal Stage is displayed using a blue cursor above the main Phase Bars area to show each Stage Change point. The exact time of the Stage Change Point is shown above the Stage Change Point Cursor. Stage Change points can be dragged with the mouse to change Stage lengths. LinSig will ensure constraints such as Intergreens and Phase minimums are not violated.
- **Interstages.** Interstages between Stages are shaded grey.
- **Phase Intergreens.** Phase Intergreens are displayed as green 'struts' between Phases. LinSig will normally ensure that all Intergreens are not violated however some uncommon or obscure scenarios (for example very long intergreens stretching across several Stages) can sometimes be violated. If an Intergreen is violated LinSig will display it in red, place an error in the error view, and will not produce any traffic model results.
- **Interstage and Stage Lengths.** LinSig displays the Interstage and Stage Lengths numerically in the area between Stage Change Point cursors. The times are shown in the format: 'Interstage : Stage Length'.

## Changing Stage Change Points, Stage Lengths

Stage Change Points and Stage Lengths can all be changed graphically by dragging the blue Stage Change Point Cursors with the mouse. This will change the Stage Change Points in the current Scenario whilst keeping the Cycle Time the same.



## Changing Stage Stream Offsets

A Stage Stream's Offset can be changed by dragging a Stage Change Point whilst holding the SHIFT key down.

### 3.9.1.3. Optimising Signal Timings

Signal Timings can be optimised for the current Scenario in the following ways:

- To minimise delay in the whole Network by adjusting stage lengths and offsets for all Stage Streams.
- To maximise PRC in the whole Network by adjusting stage lengths and offsets for all Stage Streams.
- To minimise delay for the whole Network by adjusting the stage lengths and offset for a single Stage Stream.
- To maximise PRC for the whole Network by adjusting the stage lengths and offset for a single Stage Stream.

#### Optimising Signal Timings for the Whole Network

To optimise signal timings for the whole Network choose 'Optimise for Delay' or 'Optimise for PRC' from the Optimiser menu. LinSig will adjust the signal timings of the current Scenario to minimise total traffic delay or maximise PRC for the Network.

#### Optimising Signal Timings for a Single Stream

To optimise signal timings for a single Stage Stream click 'Optimise for Delay' or 'Optimise for PRC' in the Stage Stream List in the Signal Timings View. LinSig will adjust the Stage Lengths and offset of just the individual Stage Stream to minimise traffic delay or maximise PRC.

## 3.10. Interstage View

The Interstage View is used to display and edit Interstage structures in LinSig. The Interstages can have a significant effect on junction performance and safety and it is important they are correctly designed. The Interstage View can be used to optimise Interstage structures by automatically adjusting Phase Delays and can also be used to manually adjust Phase Delays where necessary.

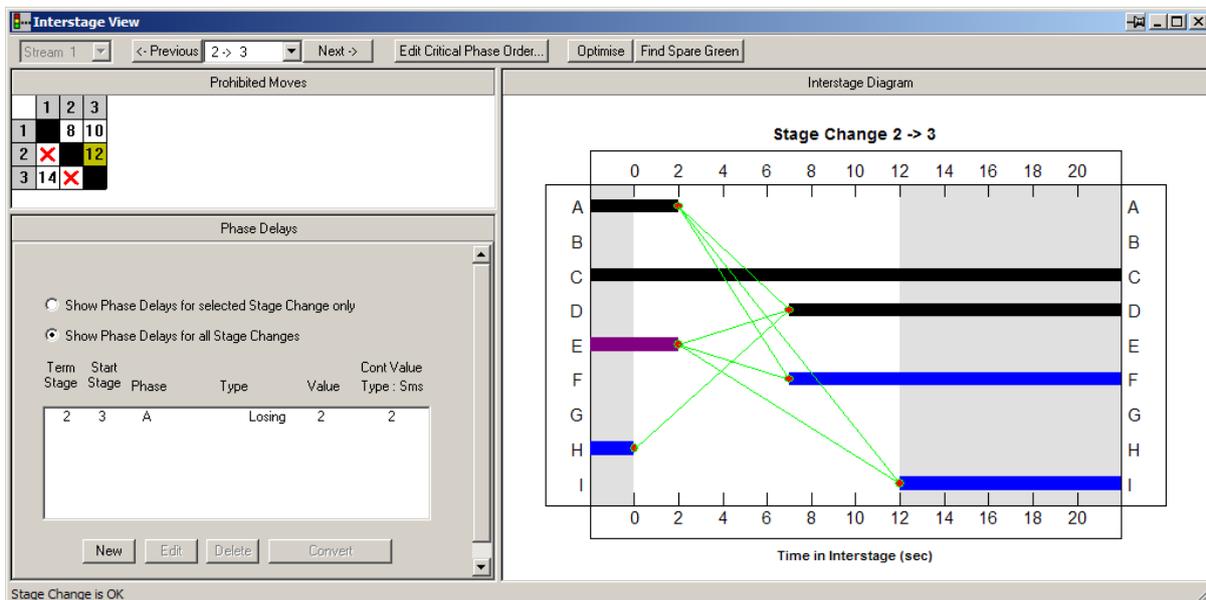
The Interstage View is used in a similar manner regardless of whether Multiple Stage Streams are being used. For more information on using Multiple Stage Streams see the Phase View section.

The Interstage View is opened by choosing 'Interstage View' from the Stages Menu.

### 3.10.1. Single and Multiple Stage Stream Use

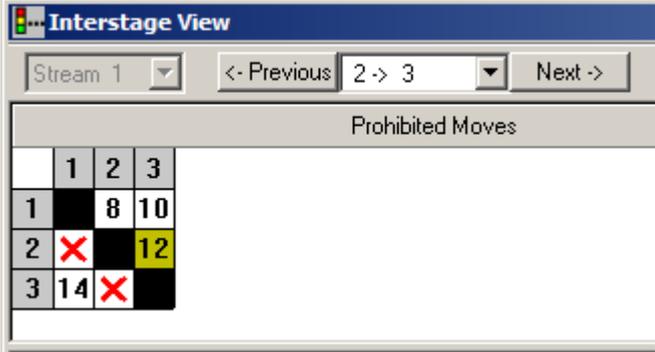
The Interstage View is comprised of several panels. These include:

- **The Prohibited Stage Change and Interstage Length Matrix.** The Prohibited Stage Change Matrix indicates Stage Changes which are prohibited either automatically by LinSig or manually by the user. The matrix also shows Interstage lengths calculated by LinSig for all allowed Stage Changes. When Multiple Stage Changes are being used the matrix is shown for the currently selected Stage Stream.
- **The Phase Delays List.** The Phase Delays List displays a list of Phase Delays configured in the Controller.
- **The Interstage Structure Panel.** The Interstage Structure Panel shows the Interstage Structure for the Interstage selected in the Prohibited Stage Change Matrix. The panel shows terminating and starting Phases, Intergreens and Phase Delays which make up the Interstage. The Panel can also be used to automatically optimise the Interstage structure.



### 3.10.1.1. The Prohibited Stage Change and Interstage Length Matrix

The Prohibited Stage Change and Interstage Length Matrix displays an Interstage matrix for the current Stage Stream.



	1	2	3
1		8	10
2	X		12
3	14	X	

The matrix displays the following:

- The currently Selected Interstage is shown with a yellow background and corresponds to the Interstage shown in the Interstage Structure panel.
- Interstages which are prohibited are marked with a cross. Interstages which are automatically prohibited by LinSig, for example to avoid violating rules regarding terminating Filter Phases, are shown in blue. Interstages which have been explicitly banned by the user are shown in red.
- Permitted Interstages display the Interstage duration calculated by LinSig. This is calculated from the Phase Intergreens and Phase Delays involved in the Interstage.

### 3.10.1.2. The Current Interstage and Selecting an Interstage

When LinSig needs to display or perform an action on an Interstage it needs to know which one to use. The Interstage View allows an Interstage to be selected by either:

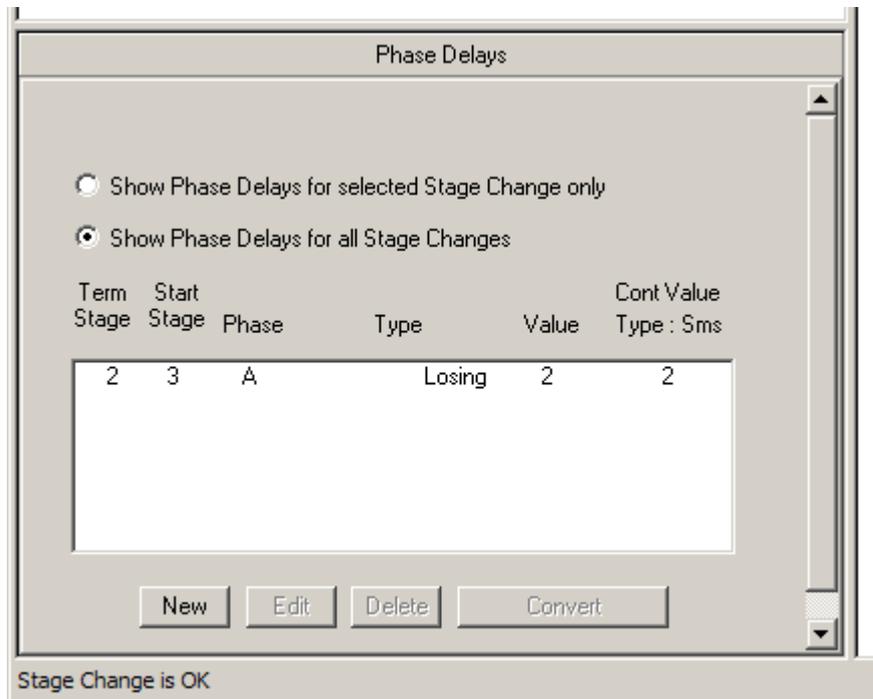
- Clicking an Interstage in the Prohibited Stage Change Matrix. The selected Interstage is highlighted with a yellow background.
- Selecting an Interstage from the drop down list in the Interstage View toolbar.
- Using the 'Previous' and 'Next' buttons in the toolbar to cycle through Interstages in sequence.

The Interstage Structure Diagram will always show the detailed structure of the current Interstage.

When multiple Stage Streams are in use Interstages are shown for the current Stage Stream only. The current Stage Stream can be changed using the drop down list in the Interstage View's toolbar or in the Stage View, Signal Timings View or Phase View. Using multiple Stage Streams is covered in more depth in the Phase View section.

### 3.10.1.3. The Phase Delays List

The Phase Delays List displays a list of Phase Delays configured on the controller and is also used to create, edit and delete Phase Delays. For more information on Phase Delays and how they are used see the information on Phase Delays in the 'Background' section.



The information shown for each Phase Delay is as follows.

- The terminating and starting stages for which the phase delay is active.
- The Phase associated with the phase delay.
- The type of the Phase Delay. Phase Delay Types are described below.
- The Phase Delay value (seconds) in the LinSig model.
- The Phase Delay value (seconds) for the current controller type. The current controller type is shown at the top of the column.

#### Controlling the Phase Delay List

The Phase Delay List shows the Phase Delays currently configured on the Controller. If Multiple Stage Streams are being used only Phase delays for the Current Stage Stream are listed. The Current Stage Stream can be changed using the drop down list in the Interstage View toolbar, on the main LinSig toolbar or in the Phase or Stage Views. See the sections on the Phase View and Stage View for more information on using multiple Stage Streams.

The Phase Delay List can be very long for complex models and can be further filtered by choosing to show Phase Delays for the currently selected Stage Change only.

#### Phase Delay Types

Phase Delays can be of two basic types. These are:

- **Phase Losing Delays.** These are Phase Delays associated with Phases which lose right of way in the Phase Delay's associated Stage Change. These are the most commonly used Phase Delay and are often used to assist with optimising Interstages. The Phase Delay's value defines how long the Phase will continue to run for after the terminating Stage ends.

- **Phase Gaining Delays.** These are Phase Delays associated with Phases which gain right of way in the Phase Delay's associated Stage Change. These are much less common than Phase Losing Delays and are typically used to align the starting point of Phases in an Interstage. This is sometimes desirable when different Intergreen values would cause Phases to start at different times in a potentially unsafe manner. A Phase Gaining Delay delays the start of a Phase after the point it would start – normally when all intergreens to the Phase have completed. Phase Gaining Delays can be specified in two different ways in LinSig as described below.

LinSig will automatically determine the type of a Phase Delay based on its associated Phase and Stage Change.

As signal controllers supplied by different manufacturers define a Phase Gaining Delay's value in different ways, LinSig has introduced two variants of Phase Gaining Delay to allow all controller types to be accommodated. These are:

- **Absolute Phase Gaining Delay.** An Absolute Phase Gaining Delay delays the start of a Phase by the Phase Delay's value timed from the end of the terminating Stage.
- **Relative Phase Gaining Delays.** A Relative Phase Gaining Delay delays the start of a Phase by the Phase Delay's value timed from the point the Phase would have started if the Phase Delay did not exist.

Each Phase Gaining Delay can be entered in either form in LinSig. As well as displaying the value of a Phase Gaining Delay as it is defined LinSig will also calculate its value in the native form used by the current Controller Type.

Controller Manufacturers specify phase gaining delays as follows:

- **Siemens/Plessey** - Absolute but deduct red/amber time on traffic phases.
- **GEC** - Absolute.
- **Peek/Ferranti** - Relative.
- **Microsense/TSEU** - Relative.
- **Monitron** - Relative.

### Creating a New Phase Delay

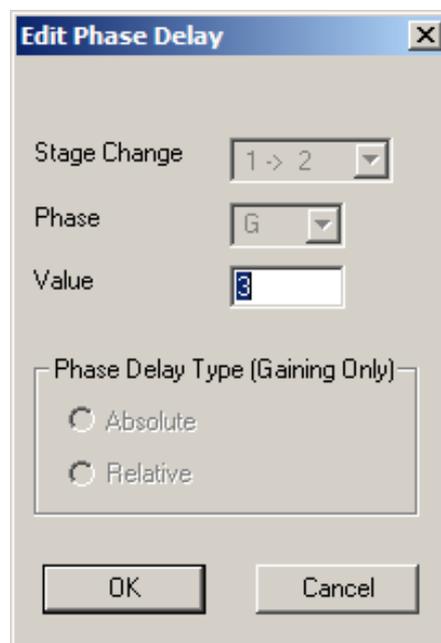
A new Phase Delay is created by clicking 'New' in the Phase Delay List panel. This will create a new Phase Delay and display the 'New Phase Delay' dialog box.

The following information is required for a new Phase Delay:

- **The Phase Delay's Stage Change.** Select the Stage Change associated with this Phase Delay from the drop down list. If a Phase has already been selected only Stage Changes compatible with this Phase are displayed.
- **The Phase Delay's Phase.** Select the Phase associated with this Phase Delay from the drop down list. If a stage change has already been entered only the Phases compatible with this Stage Change are shown.
- **The Phase Delay Value.** Enter the length of the Phase Delay in seconds.
- **The Phase Delay Type.** The Phase Delay type is only required for Phase Gaining Delays. LinSig will use the Stage Change and Phase to determine whether the Phase Delay being entered is a Phase Gaining Delay. More information on Phase Delay Types is given in 'Phase Delay Types' above.

### Editing a Phase Delay

Phase Delays are edited by selecting the Phase Delay in the Phase Delay List and clicking 'Edit'. This opens the 'Edit Phase Delay' dialog box.



The following information can be edited for Phase Delays:

- **The Phase Delay Value.** Enter the length of the Phase Delay in seconds.
- **The Phase Delay Type.** The Phase Delay Type is only required for Phase Gaining Delays. LinSig will use the existing Stage Change and Phase to determine whether the Phase Delay being entered is a Phase Gaining Delay. More information on Phase Delay Types is given in 'Phase Delay Types' above.

When Editing a Phase Delay the Stage Change and Phase cannot be changed. If necessary the Phase Delay should be deleted and a new Phase Delay created with the correct Stage Change and Phase.

### Deleting Phase Delays

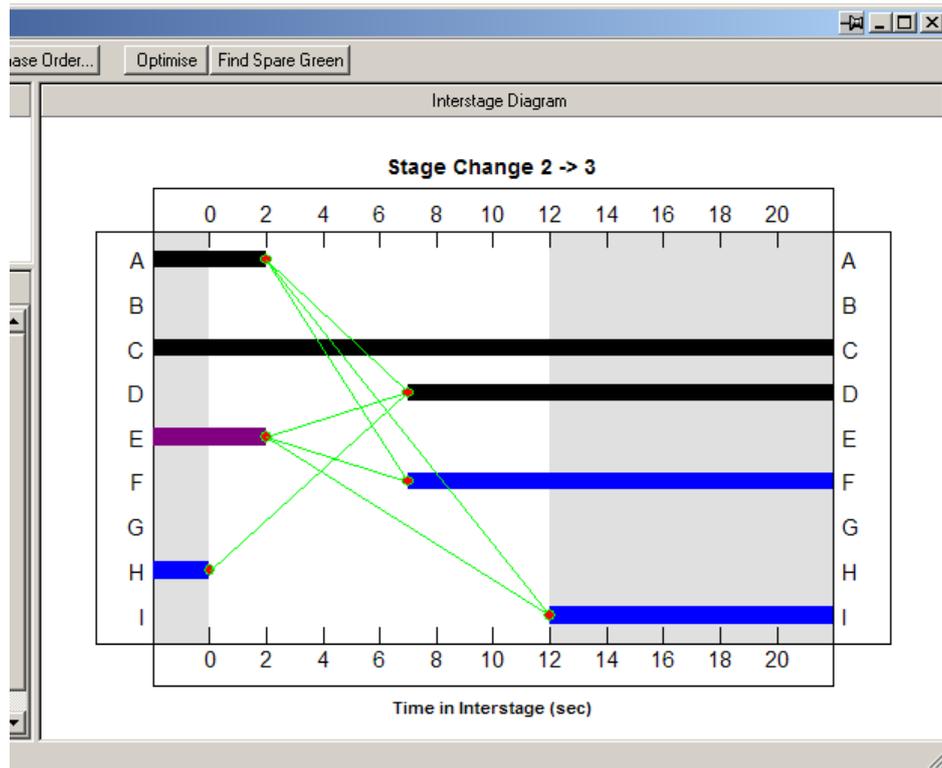
A Phase Delay can be deleted by selecting it in the Phase Delay List and clicking 'Delete'.

## Converting Phase Gaining Delays

Phase Gaining Delays are entered either as Absolute Phase Gaining Delays or Relative Phase Gaining Delays as detailed above. A Phase Delay can be permanently converted from one type to the other as follows:

- Select the Phase Delay in the Phase Delay List.
- Click the 'Convert to Relative' or Convert to Absolute' button as appropriate. LinSig will change the type of the Phase Gaining Delay and recalculate its value to reflect its new type.

### 3.10.1.4. The Interstage Structure Diagram



The Interstage Structure Diagram shows the following:

- **Terminating Phases.** The Phases terminating in this Interstage are shown to the left of the panel. Each Phase is coloured according to its Phase type as defined in the Phase View. Phases may terminate within the Interstage when they have Phase Losing Delays defined.
- **Starting Phases.** The Phases starting in this Interstage are shown to the right of the panel. The Phases start when Intergreens from other Phases or Phase Gaining delays terminate.
- **Phase Intergreens.** The Phase Intergreens are shown as green 'struts' separating Phases.

The Interstage Diagram initially accommodates Interstages up to 20 seconds and marks the time axis every two seconds. This can be changed if necessary by double clicking on the time axis and entering a new size and scale as appropriate.

#### Using Phase Delays to Adjust Phase Termination and Start Times

The Interstage View can be used to adjust the start and end times of Phases within the Interstage. LinSig implements these adjustments using Phase Delays.

The termination point of a Phase can be delayed by dragging the end of the Phase with the mouse to set a new end time. LinSig will create a Phase Losing Delay to implement the new Phase end time. This Phase delay will also appear in the Phase Delay List. If the Phase end time is dragged back to the start of the Interstage the Phase Delay is no longer necessary and is removed by LinSig.

The start time of a Phase will initially be determined using the end times of terminating Phases, and Intergreens from the terminating Phases to the starting Phases. The start time of a starting Phase can be delayed by dragging to the right with the mouse. LinSig implements this as a Phase Gaining Delay which will be shown in the Phase Delay List. As for Phase Losing Delays, if the Phase start time is dragged so that the Phase Delay is no longer necessary LinSig will delete the Phase Delay.

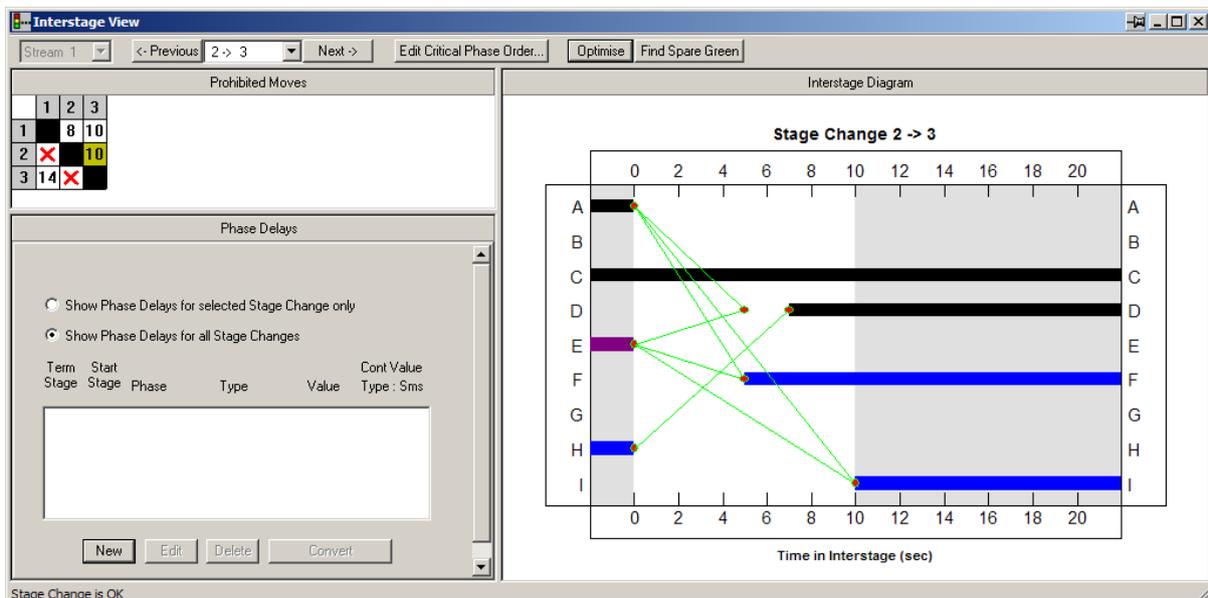
### Optimising Interstages

LinSig provides two mechanisms for determining the optimum set of Phase Delays for an Interstage. These are:

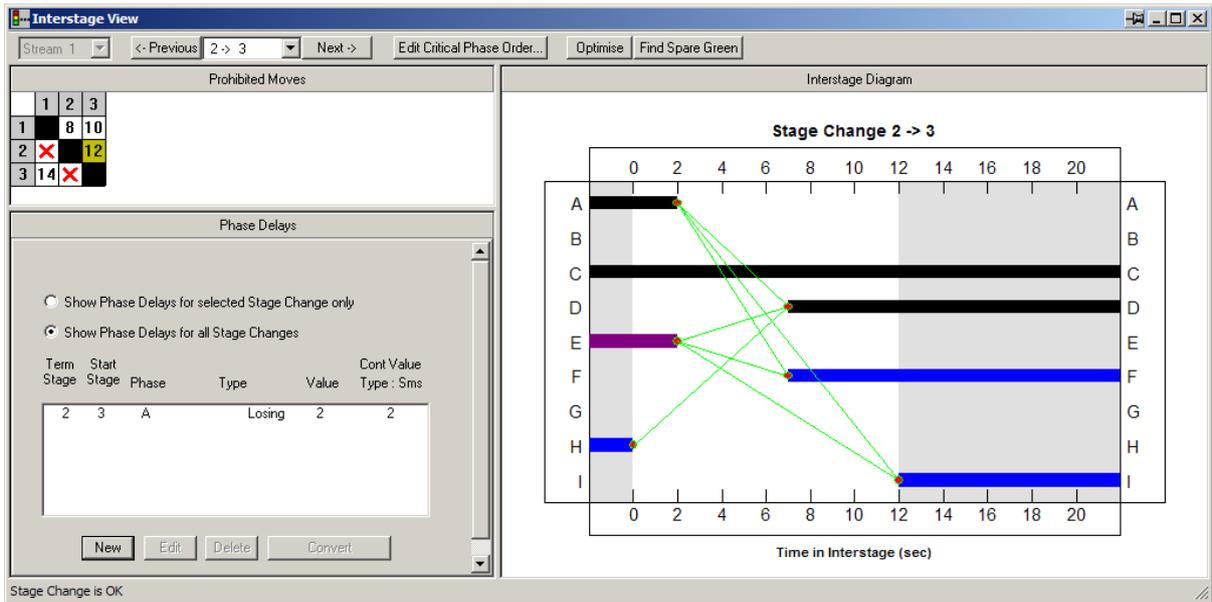
- **Find Spare Green.** This is a basic method which simply extends terminating Phases without causing any starting Phases to start later. This optimisation is carried out by clicking 'Find Spare Green' in the Interstage View toolbar.
- **Full Optimisation.** This much more sophisticated method optimises the Interstage to ensure critical terminating and starting Phases have the minimum separation, usually equal to their Intergreen, between them.

### Interstage Optimisation

Interstage optimisation is run by clicking 'Optimise' in the Interstage View's toolbar. It is important to setup a Critical Phase order before running the optimiser. The diagrams below shows the same Interstage before and after it has been optimised by adding a two second Phase Delay to Phase A. Even though the Interstage is longer it is more efficient as the separation of Phases A and D has been reduced to the minimum possible. In this case the IGA Phase E is also extended as it terminates when its associated Phase A terminates.



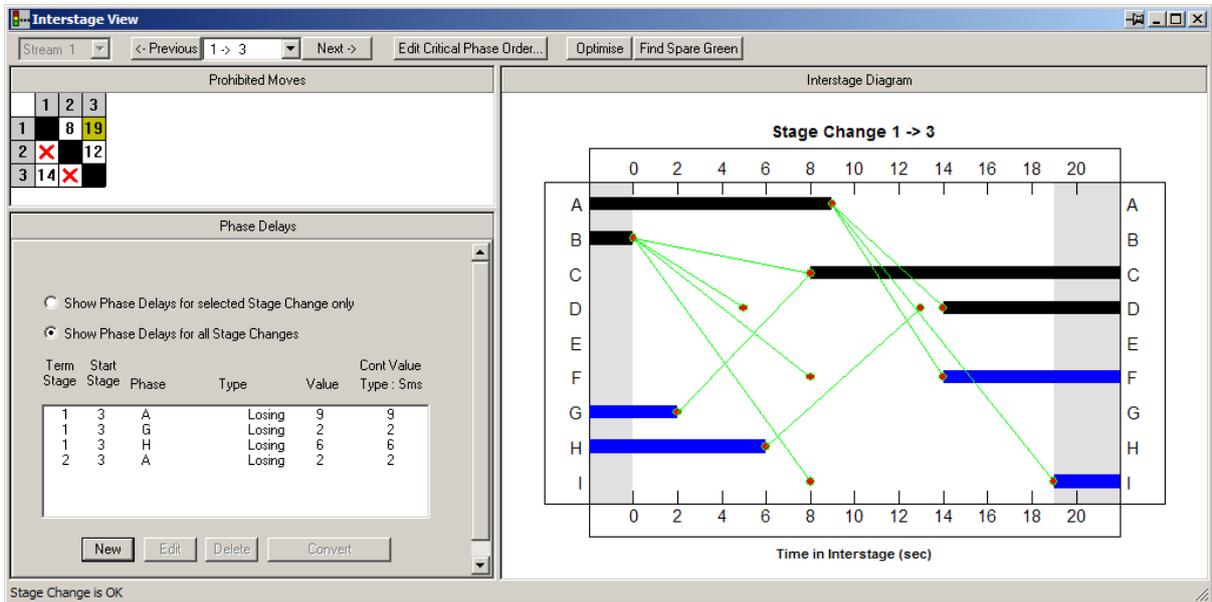
Before Interstage Optimisation



After Interstage Optimisation

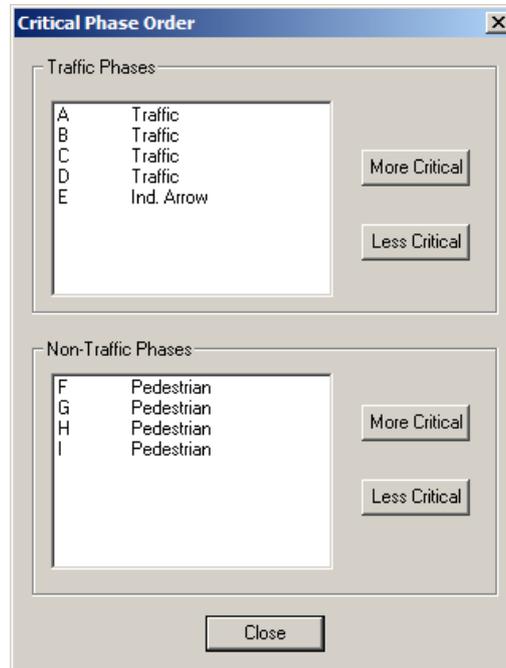
### Overlapping Phases in Interstage

Where Interstages allow terminating and starting Phases to overlap LinSig will only optimise the Interstage up to the point the Phases would overlap. A design decision is required whether to overlap the Phases in the Interstage or whether to create a new Stage based on the overlapping Phases. The diagram below shows a different Interstage with Phases A and C overlapping.



## Setting the Critical Phase Order for Interstage Optimisation

The Critical Phase Order for Interstage Optimisation is set using the Critical Phase Order dialog box which is opened by clicking 'Edit Critical Phase Order...' on the Interstage View toolbar. The Critical Phase order governs the priority with which LinSig optimises the separation of terminating and starting Phases.



Phases are ordered in two separate lists: Traffic Phases and non-traffic Phases. Traffic Phases are always treated as higher priority than all non-traffic Phases.

To change the order of Phases select a Phase in either list, and use the 'More Critical' and 'Less Critical' buttons to adjust its position.

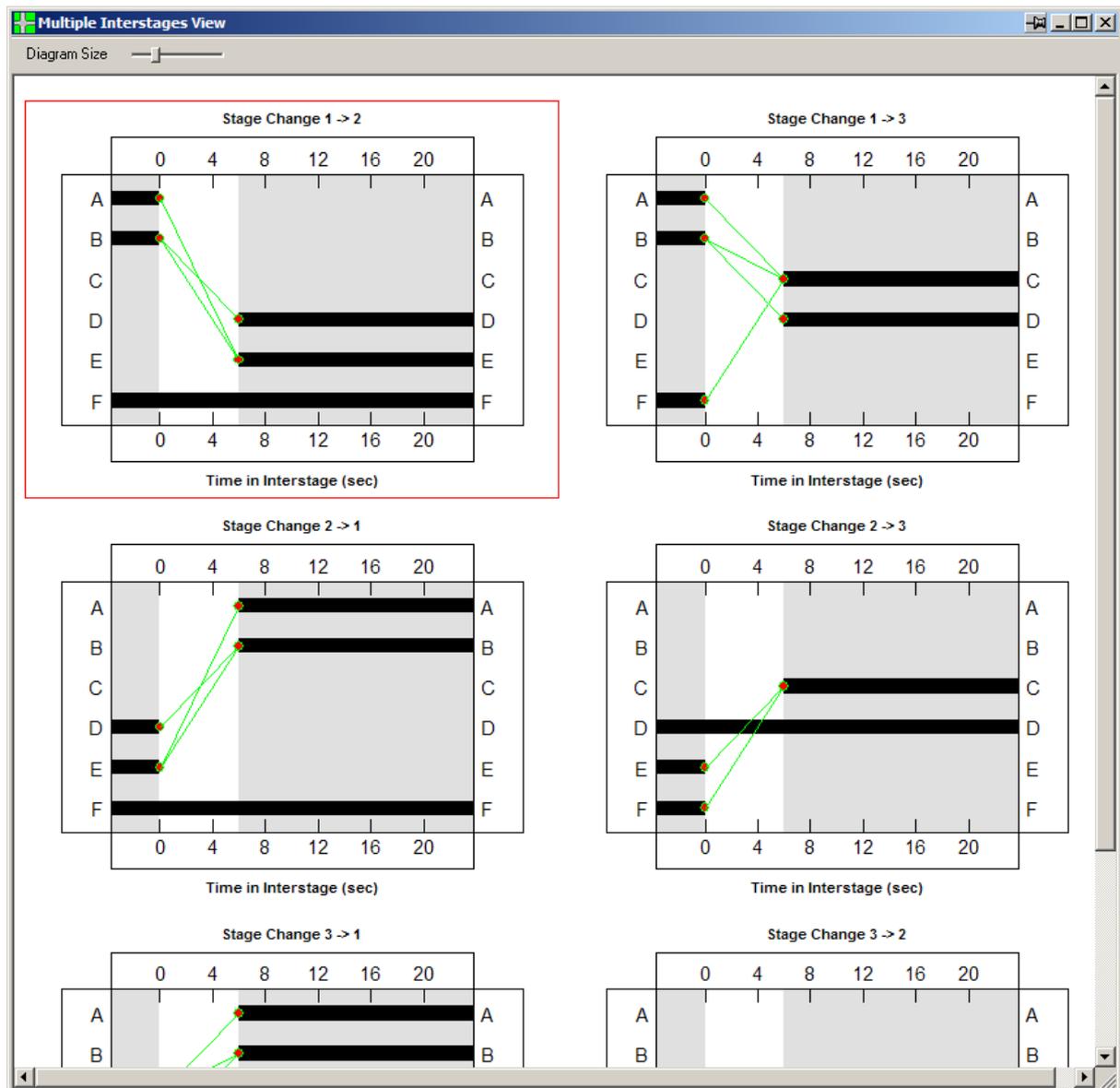
### 3.10.1.5. Checking of Interstages for Safety Issues

Interstages should always be checked by a competent engineer as badly designed Interstages can have safety implications. LinSig optimises Interstages solely from the point of view of efficiency. The subjective assessment of whether an Interstage is safe should always be done by an engineer. That is why there is deliberately no 'Optimise All Interstages' button in LinSig – It is far better practice to optimise each Interstage in turn reviewing its safety as you proceed.

## 3.11. Multiple Interstages View

The Multiple Interstages View is similar to the Interstage Structure Diagram displayed in the Interstage View. The key difference is that the Multiple Interstage View displays a number of Interstage Diagrams. This allows the Interstages be printed as a set which is useful for reference when undertaking signal controller Factory Acceptance Tests (FAT).

Although the Multiple Interstage View is primarily intended for printing purposes many of the Interstage Views features such as Phase Delay adjustment and Interstage optimisation can also be carried out in the Multiple Interstage View.



### 3.11.1.1. Adding Interstage Diagrams

Interstage Diagrams are added to the Multiple Interstage View by right-clicking on the View and choosing 'Add Interstage Diagram...' from the pop-up menu. LinSig will ask which Interstage to add before displaying the Interstage Diagram to the View.

Choosing 'Show all Allowed Interstage Diagrams', adds all non-prohibited Interstages in one step.

### **3.11.1.2. Deleting an Interstage Diagram**

To delete an Interstage Diagram, right-click the diagram with the mouse and choose 'Delete Interstage Diagram' from the pop-up menu.

### **3.11.1.3. Repositioning Interstage Diagrams**

Interstage Diagrams can be repositioned in the View by selecting a Diagram with the mouse and dragging it to a new position.

### **3.11.1.4. Adjusting the size of Interstage Diagrams**

The 'Diagram Size' slider on the Multiple Interstage View toolbar can be used to adjust the screen display size of Interstage Diagrams.

### **3.11.1.5. Adjusting the Interstage Diagrams Time Axis Scaling**

The scaling of the Interstage Diagrams' time axis can be changed by double clicking on the time axis of any Interstage Diagram. This allows the time axis width and tick interval to be adjusted.

### **3.11.1.6. Printing the Interstage Diagrams**

The Interstage Diagrams can be printed by choosing 'Print' or 'Print Preview' from the File menu. This will display the Print Options dialog box which allows the layout of Interstage Diagrams on the printed page to be set. LinSig will then use the order of Interstage Diagrams in the Multiple Interstage View to determine the position of each Diagram on the printed page.

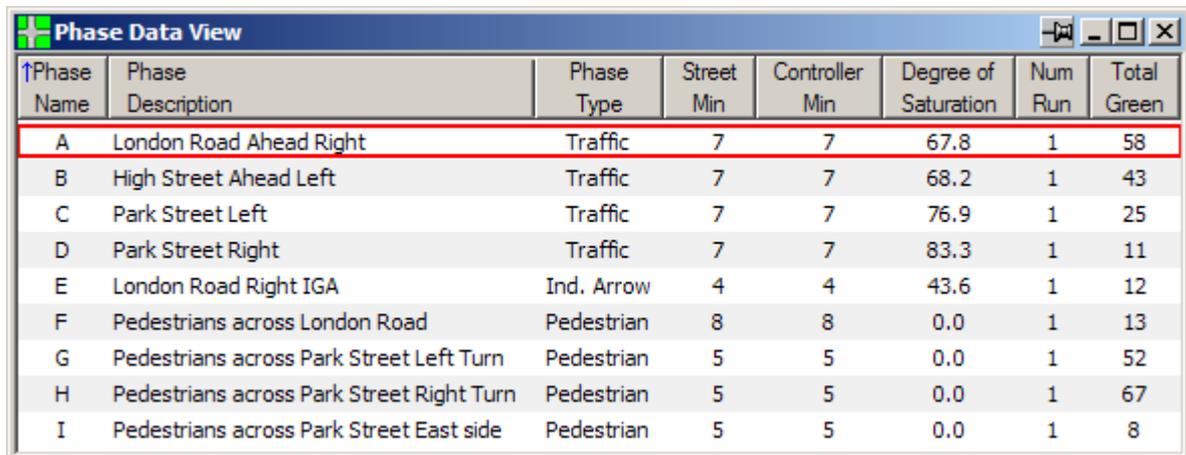
More information on Printing and setting general Print options is available in the 'General View Features' section.

### **3.11.1.7. Exporting the Interstage Diagrams to Graphics Software**

The Interstage Diagrams can be exported to other graphics software either as a Windows Metafile or in DXF format which can be imported into most Cad software. Further details are given in the 'General View Features' section.

## 3.12. Phase Data View

The Phase Data View shows information for each Phase in a tabular format. The View can be opened by choosing 'Phase Data View' from the Phase menu.



Phase Name	Phase Description	Phase Type	Street Min	Controller Min	Degree of Saturation	Num Run	Total Green
A	London Road Ahead Right	Traffic	7	7	67.8	1	58
B	High Street Ahead Left	Traffic	7	7	68.2	1	43
C	Park Street Left	Traffic	7	7	76.9	1	25
D	Park Street Right	Traffic	7	7	83.3	1	11
E	London Road Right IGA	Ind. Arrow	4	4	43.6	1	12
F	Pedestrians across London Road	Pedestrian	8	8	0.0	1	13
G	Pedestrians across Park Street Left Turn	Pedestrian	5	5	0.0	1	52
H	Pedestrians across Park Street Right Turn	Pedestrian	5	5	0.0	1	67
I	Pedestrians across Park Street East side	Pedestrian	5	5	0.0	1	8

The Phase Data View shows the following information for each Phase:

- **The Phase Letter.**
- **The Phase Description.** This is automatically generated by LinSig using information from the Links controlled by this Phase.
- **The Phase Type.** The different Phase Types are explained in the Phase View section.
- **The Street Minimum.** This shows the Street Minimum value for this Phase. This is only applicable if the 'Treat Phase Minimums as Street Minimums' option is chosen in the Controller Information Dialog. If not LinSig only uses Controller Minimums and Streets Minimums are not relevant.
- **The Controller Minimum.** This Shows the Controller Minimum value for this Phase. See 'Phase Minimums' in the Technical Reference for more detailed information on Phase Minimums. The Controller Minimum can be derived in two ways:
  - If the 'Treat Phase Minimums as Controller Minimums' option is chosen in the Controller Information Dialog the Controller Minimum is taken as the Phase Minimum Value set for the Phase.
  - If the 'Treat Phase Minimums as Street Minimums' option is chosen the Controller Minimum is calculated from the supplied Street Minimum.
- **The Degree of Saturation.** The Degree of Saturation of the worst Link controlled by the Phase.
- **The Number of Runs.** This shows the number of times this Phase runs each cycle in the current Staging Plan.
- **The Total Green Time.** This shows the total time this Phase is green each cycle.

The Phase Data View is for display purposes only and is not used to edit Phases. All Phase Editing is carried out in the Phase View.

### 3.13. Stage Minimums View

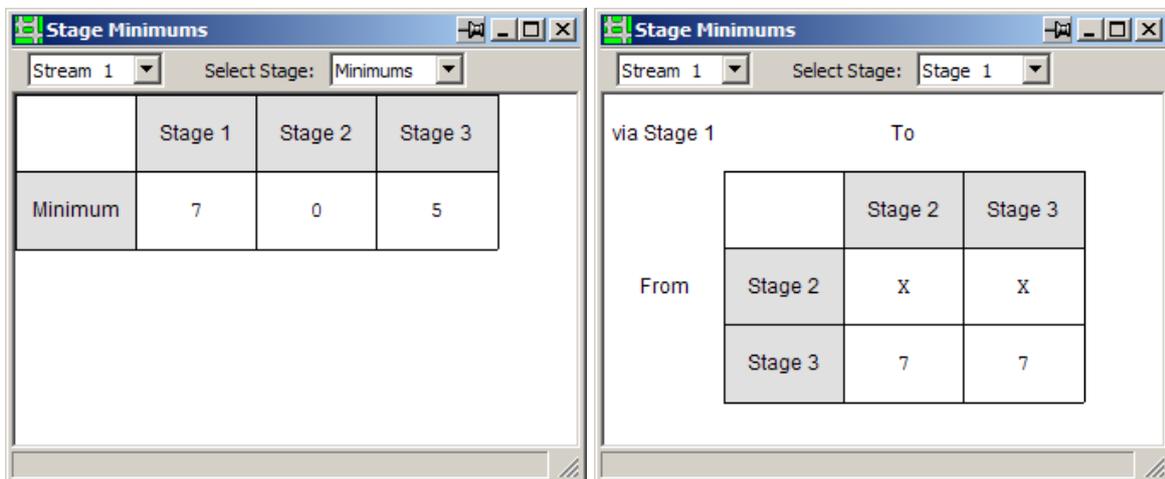
The Stage Minimums View provides a detailed analysis of the Stage Minimum times for all possible Stage orders. The way Stage minimums differ for different stage orders, especially the minimum possible value of Stage Minimum for all stage orders, is important when configuring parameters for fault monitoring and UTC systems.

The Stage Minimums View can be opened by choosing 'Stage Minimums View' from the Stages menu.

The View is used in a similar manner regardless of whether Single or Multiple Stage Streams are being used. The information shown is for the current Stage Stream which can be changed if necessary in the main toolbar or the Phase, Stage or Signal Timings View.

The Stage Minimums View has two main displays as shown below. These are:

- **The Stage Minimum Matrix.** This shows the Stage minimums for a Stage for all possible 3-Stage sequences of preceding and succeeding Stages.
- **The Minimum Stage Minimums Summary.** This shows a summary of the Minimum possible Stage Minimum when considering all possible Stage orders.



#### 3.13.1.1. The Stage Minimum Matrix

LinSig shows a Stage Minimum Matrix for each Stage in the Current Stage Stream. As Stage Minimums are calculated from Phase Minimums a Stage's minimum may be different depending on the Stages running before and after it. The Stage Minimum Matrix shows the Stage Minimum for the subject Stage for all combinations of preceding and succeeding Stages, allowing the spread of minimums to be ascertained.

For example, for Stage 1 LinSig will calculate the Stage Minimums for Stage 1 in the sequences 3-1-2 and 3-1-3. Normally sequences 2-1-2 and 2-1-3 would also be considered but the Stage change 2-1 is prohibited in this example.

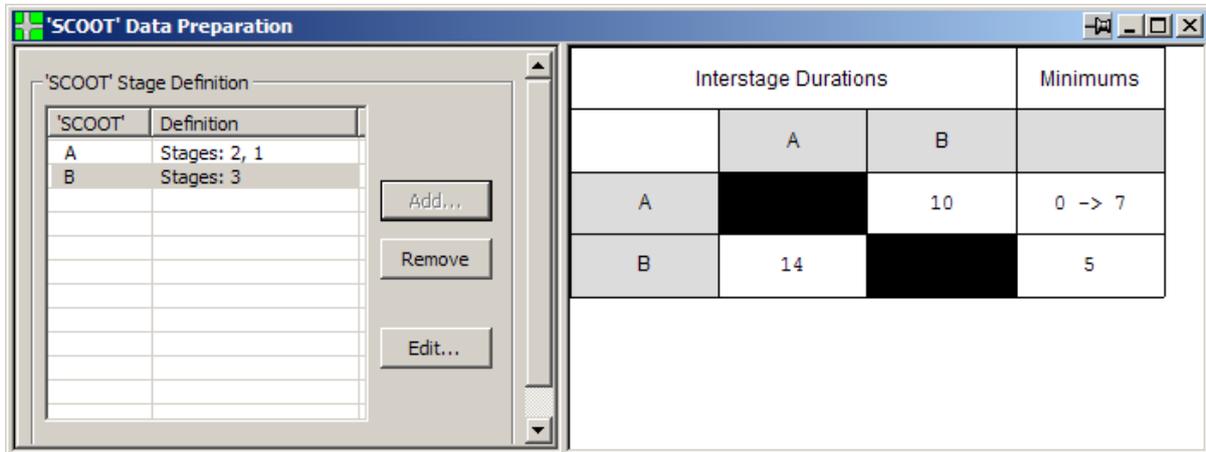
#### 3.13.1.2. The Minimum Stage Minimums Summary

The Minimum Stage Minimums Summary summarises the different Stage Minimum Matrices by showing the Minimum Stage Minimum for each Stage. This is useful when configuring fault monitoring and UTC systems.

## 3.14. SCOOT Data Preparation View

The SCOOT Data Preparation View assists with calculating a range of data useful in preparing SCOOT and UTC databases.

If multiple Stage Streams are being used the View displays information for the current Stage Stream. This can be changed either by selecting a new Stage Stream in the main toolbar or by changing the current Stage Stream in the Phase, Stage or Signal Timings View.



The SCOOT Data Preparation View consists of two main components. These are:

- **The SCOOT Stage Definition List.** This allows SCOOT Stages to be defined as either sets of alternative Controller Stages or as Controller Phases.
- **The Interstage and Minimums Results Matrix.** This displays a SCOOT Interstage matrix and SCOOT Stage Minimum matrix.

### 3.14.1.1. The SCOOT Stage Definition List

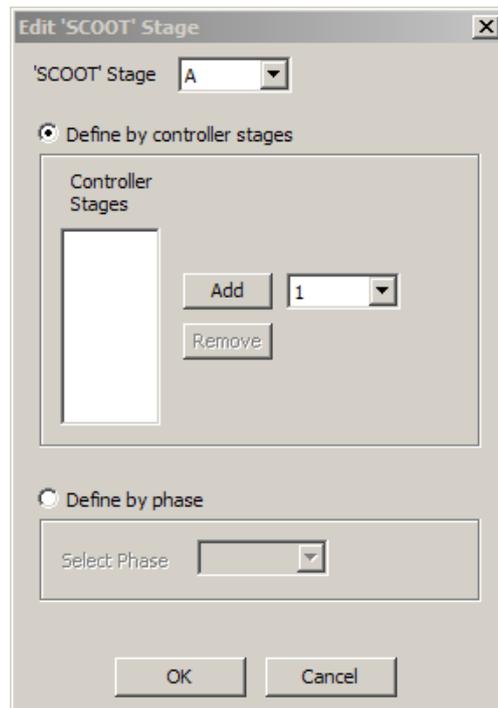
The SCOOT Stage Definition List lists currently defined SCOOT Stages.

#### Adding a new SCOOT Stage

To add a new SCOOT Stage click 'Add...' to the right of the SCOOT Stage Definition List. This will create a new SCOOT Stage and display the Edit SCOOT Stage dialog box for the Stage. This can then be used as described below to set up the SCOOT Stage.

#### Editing SCOOT Stages

To Edit a SCOOT Stage, select it in the SCOOT Stage Definition List and click 'Edit...' to the right of the List. This will open the Edit SCOOT Stage dialog box as shown below.



The Edit SCOOT Dialog box allows the following settings to be edited:

- **The SCOOT Stage Name.** The name of the SCOOT Stage being added or edited. Generally SCOOT Stages are represented by letters unlike controller Stages which are numbered.
- **The Controller Stages defining the SCOOT Stage.** SCOOT Stages can have one or more alternative Controller Stages allocated to them. For example, although SCOOT will always run Stage A the Controller may be running either Stage 1 or 2 during this period. To add a Controller Stage to the SCOOT Stage select a Controller Stage from the drop down list and click 'Add'.
- **The Phase defining the SCOOT Stage.** Some SCOOT systems allow SCOOT Stages to be defined in terms of Controller Phases rather than Controller Stages, the SCOOT Stage being deemed to run from the start to the end of the Phase. To define a SCOOT Stage as a Controller Phase, choose 'Define by Phase' and select the Controller Phase from the drop-down list.

When the SCOOT Stage is correctly defined click OK to close the Edit SCOOT Stage dialog box and apply any changes to the SCOOT Stage. Clicking Cancel will discard any changes made in the Edit SCOOT dialog box, or if adding a new SCOOT Stage discards the Stage.

### 3.14.1.2. The Interstage and Minimums Results Matrix

The Interstage and Minimums Results Matrix displays the following:

- **A SCOOT Interstage Matrix.** This shows the range of values the Interstage between two SCOOT Stages may take. This is calculated from the range of Controller Interstages occurring when different alternative Controller Stages or Phases are used for the SCOOT Stage.
- **A SCOOT Stage Minimums Table.** This shows the range of SCOOT Stage minimums which can occur for a SCOOT Stage taking into account the different Controller Stages or Phases which can be represented by the SCOOT Stage.

## 3.15. Link Results View

The Link Results View displays a range of detailed performance statistics and data for each Link. The View can be opened by choosing 'Link Results View' from the Analysis menu.

The figure below shows an example of the Link Results View showing a selection of data items. Results are always shown for the currently selected Scenario as shown in the Scenario View or main toolbar.

↑ Lnk Num	Lnk Typ	Ful Phs	Arr Phs	Num Gm	Tot Gm	Arr Gm	Flw pcu	MxSat pcu/h	AvSat pcu/h	Cap pcu	Deg Sat	IGm pcu	Gaps pcu	Unopp pcu	TDly pcuh	Dly s/pcu	MMQ pcu
1/1	U	A		1	58		800	1800	1800	1180	67.8				3.2	14.3	13.3
1/2	O	A	E	1	58	12	300	1800	1051	689	43.6	7	243	50	1.6	19.6	5.1
2/1	U	B		1	43		200	1800	1800	880	22.7				0.9	15.9	3.0
2/2	U	B		1	43		600	1800	1800	880	68.2				4.0	24.0	12.4
3/1	U	D		1	11		200	1800	1800	240	83.3				4.4	78.5	7.1
3/2	U	C		1	25		400	1800	1800	520	76.9				4.9	43.9	10.7

PRC for Signalled Links (%):	8.0	Total Delay for Signalled Links (pcuHr):	18.93
PRC Over All Links (%):	8.0	Total Delay Over All Links (pcuHr):	18.94
		Cycle Time (s):	90

The Link Results View is divided into three main areas. These are:

- **Display Settings.** This allows settings to be made governing the way the Link Results View displays the results.
- **The Results List.** This lists each Link displaying a range of data columns for each Link. Which data columns are displayed is fully customisable.
- **The Network Summary.** This includes a summary of the performance of each Stage Stream and of the Network as a whole.

### 3.15.1.1. Display Settings

The Link Results View Display Settings control which results are shown and how they are displayed.

#### Display type

The Link Results View can show two different listings of Link Results. These are:

- **Link Results.** A simple list of each Link showing Link data and statistics.
- **Route Layer Results.** A more detailed list breaking down the statistics for each Link by each Route passing through the Link.

The Display Type can be set using the drop down list in the Link Results Toolbar.

#### Results Filter

The Results Filter allows the Results List to be filtered by a range of criteria to reduce the amount of information shown. The filter criteria are:

- **All.** Shows all the available Links or Routes.
- **Stream.** Shows all the Links or Routes controlled by a specified Stage Stream.
- **Link.** Shows all the Routes passing through a specified Link.

- **Route.** Shows all the Links along a specified Route.
- **Show Exit Links.** If 'Show Exit Links' is un-ticked the Link Results View omits Exit Links from the Results List.

### PCU and Capacity Values

The 'PCU and Capacity Values' setting controls whether results are shown for the whole modelled time period or for a typical cycle within the modelled time period. The columns affected by this setting are:

- **Demand Flow**
- **Capacity**
- **Flow Entering Link**
- **Flow Leaving Link**
- **Right Turners in Gaps**
- **Right Turners in Interstage**
- **Right Turners When Unopposed**

Results which are expressed as a *rate*, for example flow or delay per hour, are not affected by this setting.

#### 3.15.1.2. The Results List

The Results List displays numerical data and results for the items selected using the Route Filter. The Results are shown in a number of columns which can be shown, hidden or reordered as described below.

#### Available Data Columns in the Link Results View

The Data Columns available are:

- **Link Number.** The number of the Link for which results are being shown in the format 'Arm Number/Link Number on Arm'.
- **Link Type.** The Type of the Link. Link Types are 'U' for unopposed Links and 'O' for a Give-Way Link which is opposed.
- **Stage Stream.** The number of the Stage Stream controlling this Link. Is shown as 'N/A' if multiple Stage Streams are disabled.
- **Route Position.** The sequential position of a Link along a Route when Link Results are filtered to display Links along a single Route. Shown as 'N/A' when Links are not filtered by Route.
- **Full Phase.** The Full Green Traffic Phase Controlling a Link. All signal-controlled Links will have a Full Green Phase.
- **Arrow Phase.** The Arrow Phase Controlling a Link. Arrow Phases will only ever be Filter or Indicative Arrow Phases.
- **Number of Greens.** The number of green periods for the Link per cycle.
- **Total Green (sec).** The total time the Link receives a green signal per cycle.
- **Arrow Green (sec).** The time an opposed Link receives a green arrow signal per cycle. This is only applicable for Links controlled by an Indicative Green Arrow or Filter Phase.

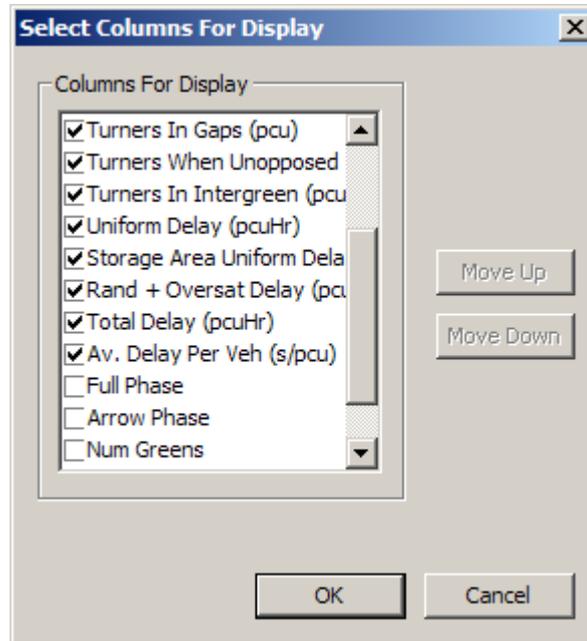
- **Demand Flow (PCU).** The total Traffic Flow in the current Flow Group wishing to travel on the Link. The Demand Flow assumes all traffic reaches the Link and does not reduce the Flow on the Link where upstream Links are overcapacity and hold back traffic.
- **Maximum Saturation Flow (PCU/hr).** The Saturation Flow on the Link at the start of green. If the Link contains short (flared) lanes the Saturation Flow will reduce below the Maximum Saturation Flow during the green period. For un-signalled non-give-way Links the Maximum Saturation Flow will be constant.
- **Average Saturation Flow (PCU/hr).** The Average Saturation Flow is calculated by LinSig as the equivalent constant Saturation flow over the green period which would give the same overall capacity on the Link as the LinSig Link Model. The Average Saturation Flow includes effects such as the reduction of Saturation Flow during the green period due to short lanes emptying, right turners being opposed, and ahead vehicles being blocked by right turners.
- **Capacity (PCU).** The Capacity of the Link is the amount of traffic which can exit the Link assuming infinite arriving traffic flows in the same turning proportions as the arriving demand traffic flows.
- **Degree of Saturation (%).** The Degree of Saturation of the Link. This is defined as the ratio of Flow to Capacity for the Link.
- **Entering Flow (PCU).** The total traffic flow entering the Link from upstream Links. This may be lower than the Demand Flow if traffic is held up on upstream oversaturated Links.
- **Leaving Flow (PCU).** The total traffic flow leaving the Link. This may be lower than the Entering Flow if the Link is oversaturated.
- **Turners When Unopposed (PCU).** The total turning flow turning during a Give-Way-Link's unopposed period, normally when an indicative green arrow is controlling the Link.
- **Turners in Gaps (PCU).** The total flow exiting a Give-Way Link during gaps in the opposing traffic.
- **Turners in Intergreen (PCU).** The flow leaving a Give-Way Link during the Intergreen.
- **Uniform Delay (PCUhr).** The total Uniform Delay suffered by traffic over the modelled time period. A more detailed description of Uniform Delay is provided in the Modelling Section.
- **Random & Oversaturation Delay (PCUhr).** The total combined Random & Oversaturation Delay suffered by traffic over the modelled time period. A more detailed description of Random & Oversaturation Delay is provided in the Modelling Section.
- **Storage Area Uniform Delay (PCUhr).** The Uniform Delay suffered by traffic in the Right Turn Storage Area in front of the stop line. This is only applicable for right turn give way Links.
- **Total Delay (PCUhr).** The sum of Uniform, Uniform Storage and Random & Oversaturation Delay. This is the total aggregate delay suffered by traffic using the modelled Network.
- **Average Delay per Vehicle (sec).** The Average Delay for each vehicle on the Link averaged over the modelled time period.

- **Back of Uniform Queue at the end of Red (PCU).** The extent of the Uniform Queue on a Link at the time the end of the Link's controlling Phase's red period. Traffic may continue to add to the back of the queue whilst the queue is clearing leading to a Maximum Back of Uniform Queue greater than the queue at the end of red. The 'Back of Uniform Queue at the end of Red' allows only for the variation of the queue within a typical cycle and does not include Random and Oversaturation queues.
- **Maximum Back of Uniform Queue (PCU).** The maximum extent of the Uniform Queue on a Link, taking into account the effect of traffic continuing to add to the back of the queue whilst traffic is discharging from the front. The Maximum Back of Uniform Queue allows only for the variation of the queue within a typical cycle and does not include Random and Oversaturation queues.
- **Random & Oversaturation Queue (PCU).** The Random & Oversaturation Queue due to non-cyclical effects (i.e. effects which last longer than a typical cycle) over the modelled time periods. The Random & Oversaturation Queue estimates the queue which will form due to (a) some cycles randomly having more or less arrivals than the typical cycle leading to an overall net increase in queue length; and (b) the steadily building queue over the modelled time period when the Link is oversaturated. Further details on this topic are provided in the modelling section.
- **Mean Maximum Queue (PCU).** The Mean Maximum Queue is the sum of the Maximum Back of Uniform Queue and the Random & Oversaturation Queue. It represents the maximum queue within a typical cycle averaged over all the cycles within the modelled time period. When a Link is oversaturated the Maximum Queue within each cycle will grow progressively over the modelled time period. This means that the Mean Maximum Queue will be approximately half the final queue at the end of the modelled time period. Please read the Modelling Section before attempting to interpret queue predictions.
- **Queue De-Sliver Threshold (PCU).** The De-Sliver Threshold displays the value entered for the Queue De-Sliver Threshold on the 'Edit Link' dialog box's 'Advanced' tab. This is useful for identifying links on which the De-Sliver mechanism has been used. More details is given in the 'Junction Layout View' Section but briefly the De-Sliver Mechanism automatically avoid long spurious queues being reported on Links when certain conditions occur.
- **Average Excess Queue (PCU).** The Average Excess Queue is the average amount the queue exceeds the stacking space on the Link defined on the 'Edit Link' dialog box's 'Advanced' tab. This is useful for monitoring how Excess Queue weightings are being applied.
- **Ignore Random Delay?** The Ignore Random Delay column indicates if Random Delay is being ignored for each Link.

## Customising the Data Columns Displayed

The Results List can be customised by adding or removing columns from the Results List. The columns shown can be changed as follows:

- Right Click on the Results List column headings and choose 'Customise' from the pop-up menu. The Select Columns dialog box will be opened.



- Tick or Un-tick columns in the Select Columns dialog box as appropriate.
- Select a column and click 'Move Up' or 'Move Down' to change the order of columns.
- Click OK to finish customising the columns.

### Show Full or Abbreviated Columns Heading

LinSig can show either full or abbreviated headings for each column show in the Results List. The full headings provide a clearer explanation of what each column shows but take up a lot of space. The abbreviated headings are much more concise but can also be a little cryptic for new users. It is suggested that abbreviated headings are used most of the time switching to full headings if you aren't sure what a column is.

To switch between full and abbreviated headings Right Click on the Results List column headings and choose 'Show Full Headings' or 'Show Abbreviated Headings' from the pop-up menu.

### 3.15.1.3. Network Summary

The Network Summary shows summary results for the entire Network broken down by Stage Stream. The following information is shown for each Stage Stream:

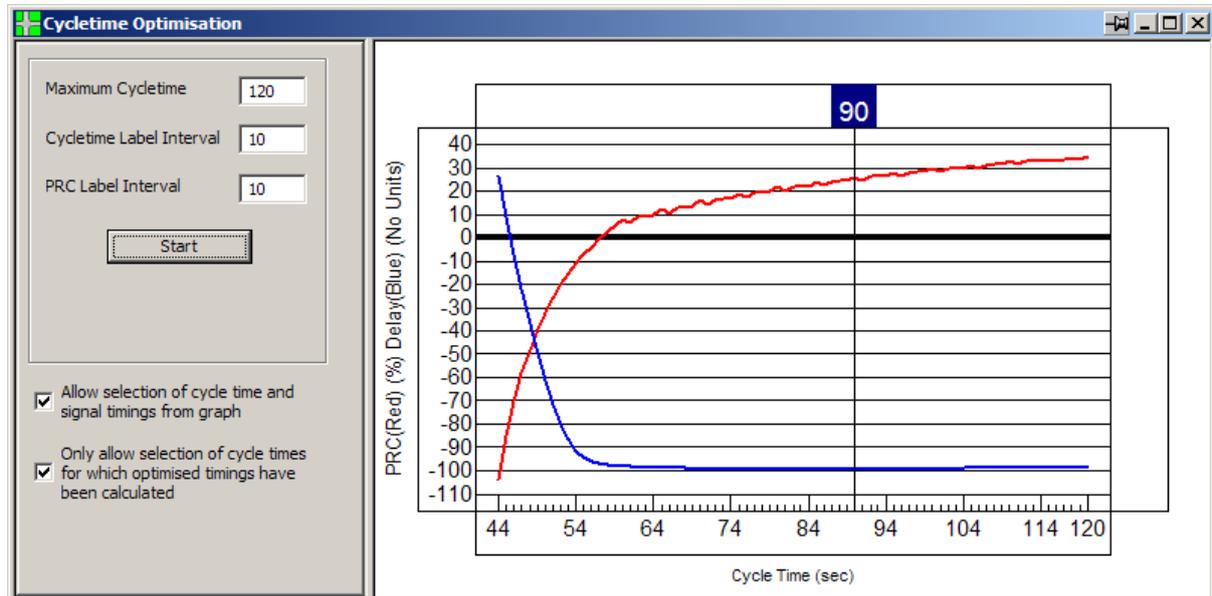
- **Practical Reserve Capacity (%).** This shows the Practical Reserve Capacity (PRC) for each Stage Stream. The PRC is calculated from the maximum degree of saturation on a Link controlled by the Stage Stream and is a measure of how much additional traffic could pass through a junction controlled by the Stage Stream whilst maintaining a maximum degree of saturation of 90% on all Links.
- **Total Delay (PCU Hr).** This shows the total aggregate delay on all Links controlled by each Stage Stream.

The following information is shown for the whole Network:

- **Total Delay for all Links (PCUhr).** This is the total delay for all Links in the Network including Exit Links. This may differ from the sum of the total delay for each Stream if the Exit Link's saturation flow is set too low and leads to delay on the Exit Links.
- **Practical Reserve Capacity (PRC) over All Links.** This is the PRC calculated from the Link with the worst Degree of Saturation in the entire Network.

## 3.16. Cycle Time Optimisation View

The Cycle Time Optimisation View displays a graph of Practical Reserve Capacity and Delay against the Network's cycle time. This allows the effect of cycle time on the Network to be assessed and an appropriate cycle time chosen.



### 3.16.1.1. Using the Cycle time Optimisation View

The Cycle Time Optimisation View displays a graph of Practical Reserve Capacity (PRC) and Network Delay for the current Scenario with optimal Stage Lengths, over a range of cycle times.

LinSig deliberately does not pick and suggest an optimal cycle time as it is far more appropriate for the engineer to decide the cycle time taking into account issues such as pedestrian safety, UTC requirements and adjacent junctions as well as the cycle time graph in the Cycle Time Optimisation View.

Unlike in LinSig V1 which produced the Cycle Time Graph instantly LinSig V2 only builds the graph when the 'Start' button is clicked. This is because the more sophisticated traffic model, the more thorough signal optimiser and the larger potential model size means that LinSig takes longer to build the cycle time curves.

The Cycle Time Optimisation View displays the following:

- **The Graph Settings.** The Graph Settings are shown in the left panel and allow the maximum cycle time to be graphed and the axis labelling to be set. The maximum cycle time should be selected carefully as having too long a cycle time can slow LinSig's calculations down significantly.
- **The Cycle time Range.** The range of cycle times is shown on the bottom axis. This range extends from the minimum cycle time for the current Staging Plan to a user defined maximum cycle time.
- **The Practical Reserve Capacity Range.** The range of Practical Reserve Capacity (PRC) is shown on the left hand axis. This range is automatically adjusted to show the full range of PRCs for the junction over the cycle time range.
- **The PRC Curve.** The red curve shows the PRC for each cycle time within the cycle time range.

- **The Total Delay Curve.** The blue curve shows the Total Delay for each cycle time in the cycle time range. The curve is shown without units as only the shape of the curve is significant in this view not the absolute values of delay. If you would like to know the absolute values of Total Delay refer to the 'Link Results View'. There is no significance to the crossing point of the PRC and delay curves.
- **The Current Cycle Time Indicator.** If the option 'Allow Selection of Cycle Time and Signal Timings from Graph' is ticked a Current Cycle Time Indicator is shown at the top of the view as a dark blue rectangle containing the current cycle time. The Cycle Time Indicator can be dragged with the mouse to change the cycle time for the current Scenario.

### 3.16.1.2. Settings and Options

The Cycle Time Optimisation View has the following Settings and Options which control how the View works:

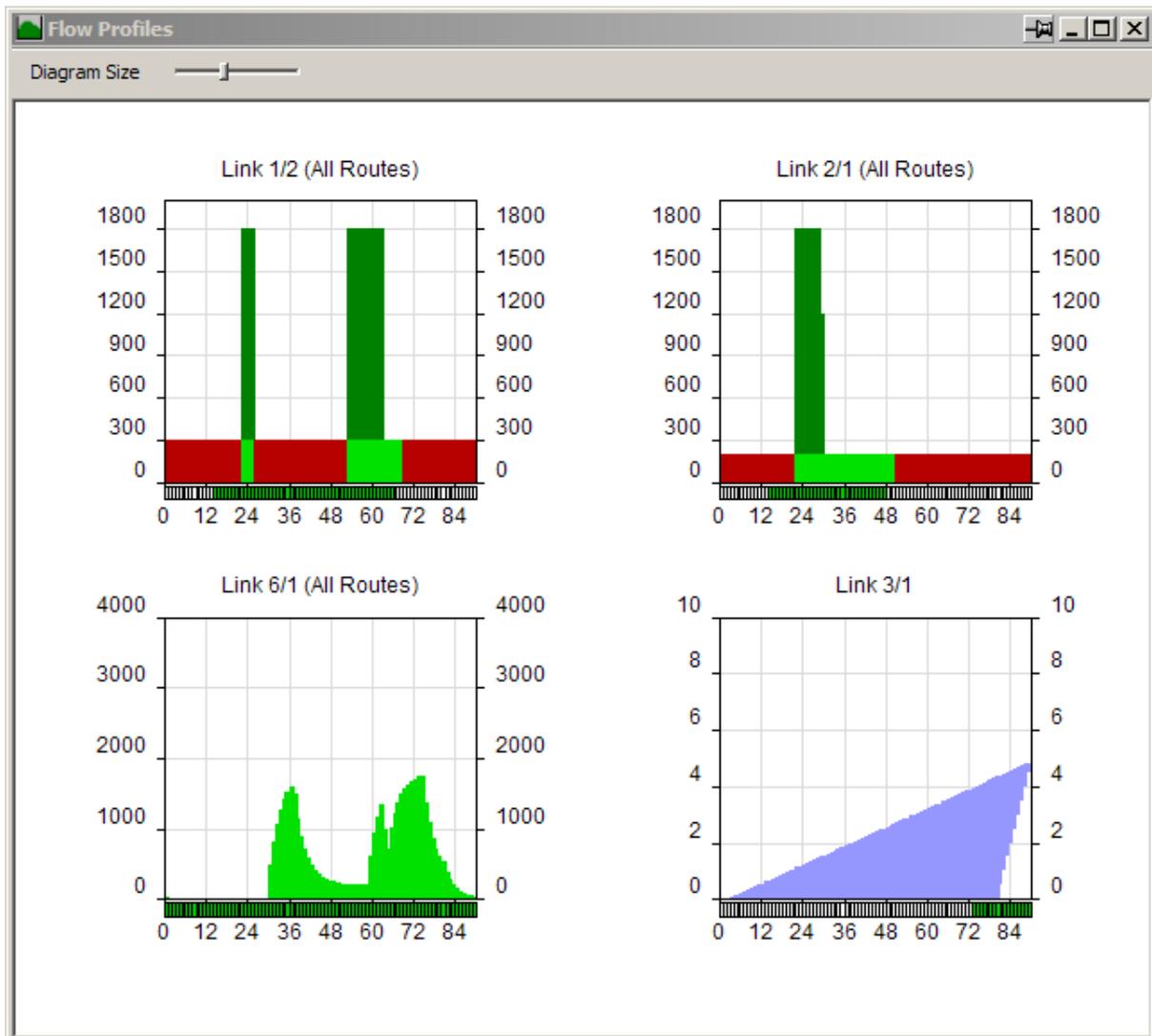
- **Allow Selection of Cycle Time and Signal Timings from Graph.** If this box is ticked the Cycle Time Optimisation View displays a cursor which can be dragged with the mouse to set the Cycle Time for the current Scenario. The Stage lengths in the current Scenario will be reset to the optimal settings for the Cycle Time if they have been calculated. If the Stage Lengths are subsequently changed in the Signal Timings View to non-optimal settings the cursor will disappear and this box will be unchecked indicating that the Scenario's timings do not match the optimal ones for the cycle time as represented in the Cycle Time Optimisation View.
- **Only Allow Selection of Cycle Times for which Optimised Timings have been calculated.** If the calculation of the Cycle Time Optimisation View has been aborted part way through some cycle times will have been optimised and some will not. If this box is ticked LinSig will only allow the cycle time cursor to select timings which have been optimised. If the box is un-ticked all cycle times can be selected with the cursor but un-optimised cycle times will use estimated Stage Lengths instead of true optimums.

### 3.17. Flow Profiles View

The Flow Profiles View displays detailed Flow Profile graphs for Links showing flow profiles calculated by the traffic model. The graphs are the same graphs as can be shown on the Junction Layout View, but the Flow Profile View allows them to be laid out on a page for printing at a larger size.

The Flow Profile View can display two types of graph. These are:

- **Flow Profile Graphs.** These show the profile of traffic flow into and out of a Link during a typical signal cycle.
- **Uniform Queue Graph.** These show the position of the front and back of the Uniform Queue on a LINK.



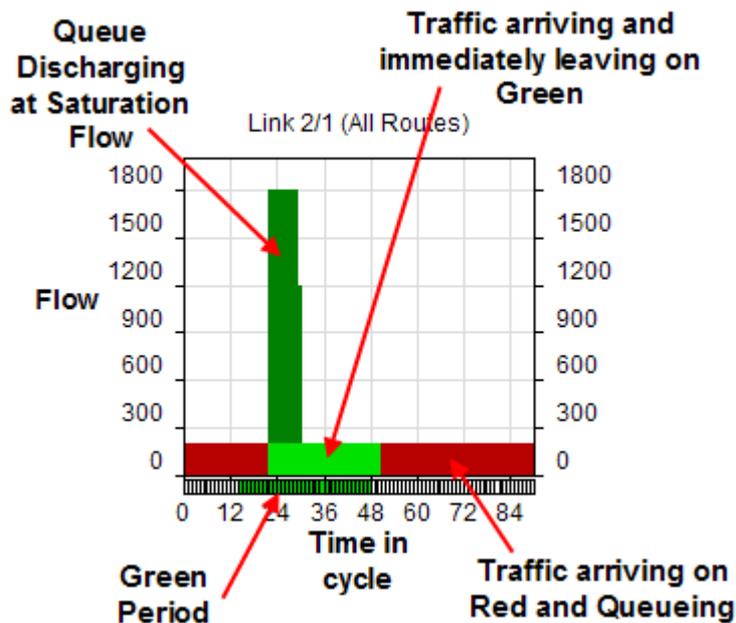
Flow Profile Graphs can only be viewed if traffic model results are available. If any errors exist preventing the traffic model from calculating results the Flow Profile Graphs will display an error message.

Further details of how the Flow Profiles are calculated and their interpretation is given in the modelling section.

### 3.17.1. Flow Profile Graphs

The Flow Profile Graphs show the traffic flow into and out of a Link over a typical signal cycle. As LinSig assumes all traffic queues vertically at the stop line, rather than spread out along the Link, all flows relate to traffic crossing the stop line as opposed to joining or leaving the queue somewhere along the Link.

A typical LinSig Flow Profile graph shows the following information. This example is for a constant arrival rate although more complex examples follow exactly the same principles.



#### 3.17.1.1. Creating Flow Profile Graphs and Controlling their Layout

The Flow Profile View allows graphs to be laid out in a rectangular grid. This creates flexibility in setting graphs out in sequence horizontally or vertically, for example to follow a Route or corridor.

##### Creating Flow Profile Graphs

Flow Profile Graphs can be added to the Flow Profile View as follows:

- Right click on the Flow Profile View with the mouse.
- Choose 'Add Graph for Link' from the pop-up menu and select the Link to be graphed.
- The new graph will be added to the Flow Profiles View and can be repositioned as desired as described below.
- Alternatively choosing 'Add Graphs for Route' from the pop-up menu adds a series of graphs in sequence for the Links along a LinSig Route.

##### Selecting a Graph

A graph can be selected by clicking it with the mouse. The graph will be highlighted with a red border indicating it is selected.

##### Repositioning Graphs

A graph can be repositioned in the Flow Profile View by selecting it with the mouse and dragging it into a new position. A solid red line will indicate the new position where the graph

will be moved to. If the graph is inserted between existing graphs the existing graphs will be moved to accommodate the new graph.

### Deleting a Graph

To delete a Flow Profile Graph select it with the mouse and choose 'Delete Graph' from the Flow Profiles menu.

### 3.17.1.2. Controlling the Display of Flow Profile Graphs

The display of Flow Profile Graphs can be customised in a number of ways. These include:

- **Graph Scaling and Sizing.**
- **Showing Inflows and Outflows on separate graphs.**
- **Showing Inflows and Outflows for the Storage Area for a Give Way Link.**
- **Showing separate graphs for each Route through a Link.**
- **Showing the individual Route Flow Components on one aggregate graph.**

### Scaling Graphs

Each graph is displayed at the same size but the flow axis can be scaled separately. To change a graph's scale:

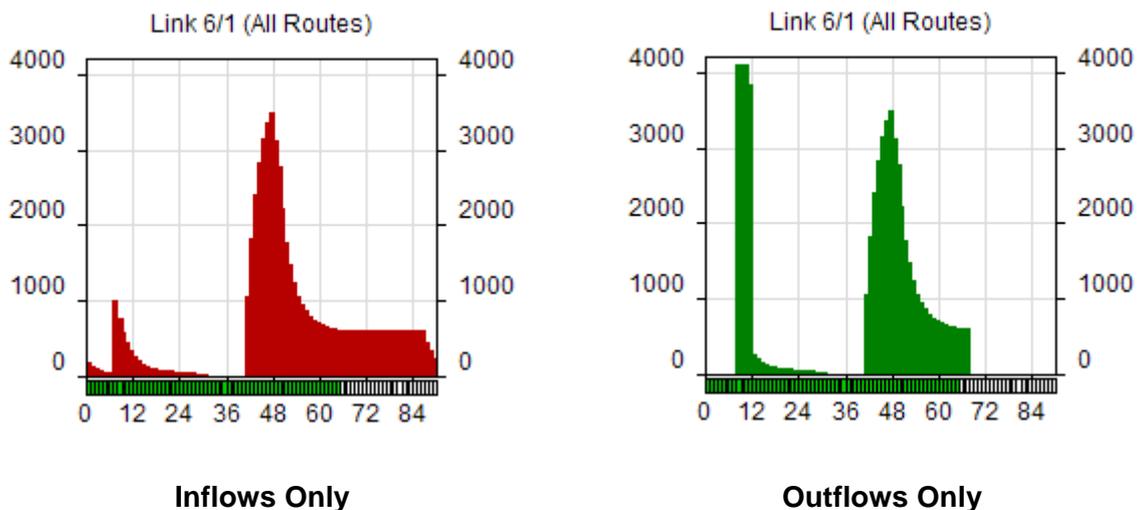
- Right-click on the graph and choose 'Set Scale' from the pop-up menu.
- Either enter a maximum value for the graph's flow axis or tick 'Autoscale' for LinSig to calculate a flow axis scale that will accommodate the graph. Autoscale is less useful when presenting a number of graphs as scales may all be different making the graphs difficult to compare.

### Sizing Graphs

All graphs are shown at the same size. The size of the graphs can be adjusted using the slider on the Flow Profiles View toolbar.

### Showing Inflows and Outflows Separately

For complex graphs it is possible to show just the Inflows or Outflows for a Link. For example:



A graph can be set to show either inflows or outflows as follows:

- Select the graph using the mouse.
- Either Right Click the graph with the mouse and choose from the pop-up menu or use the Flow Profiles menu to choose 'Show In Profile' or 'Show Out Profile' as appropriate.

### Showing Inflows and Outflows for the Storage Area for a Give Way Link.

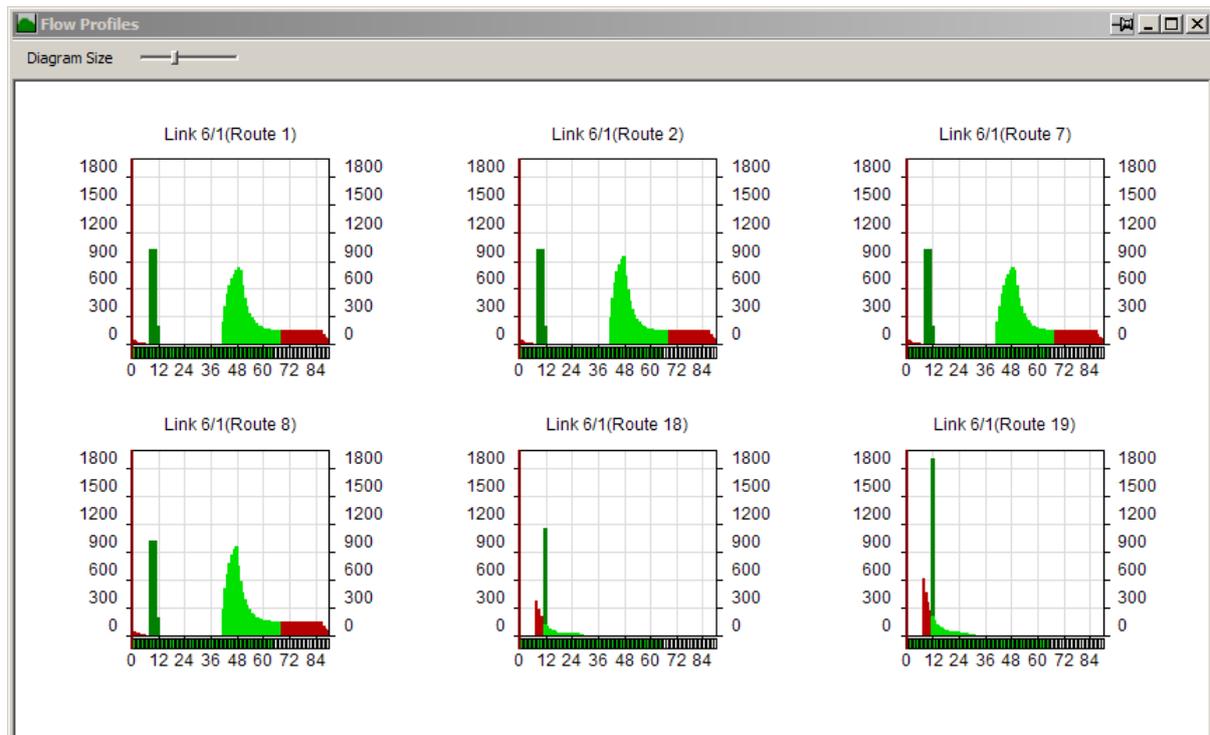
Give-Way Links can display graphs for the inflows, outflows and contents of the Give-Way Storage Area as well as ordinary Link Graphs for traffic crossing the stop line. The Storage Area is the space in front of the stop line where traffic waiting to turn right in gaps in the oncoming traffic can wait. A Storage Area Graph can be displayed as follows:

- Create the graph for the Give-Way Link in the normal way as described above.
- Right mouse click on the Graph and choose 'Show Storage Area'.
- Choose whether to view Inflows, Outflows, Inflows and Outflows together or the Storage Area Contents graph.

### Showing Separate Graphs for each Route through a Link

Whilst LinSig is modelling a Link it keeps Traffic Flows on the Routes passing through the Link separate. This allows LinSig to display the flow profiles on a Link not just for the whole Link but also for individual Route components on the Link.

For example the Flow Profiles shown above could be split into their component profiles as shown below.



Viewing separate profiles is sometimes useful when analysing a complex model and trying to identify the effects of different signalling arrangements on different traffic movements rather than on the Link as a whole.

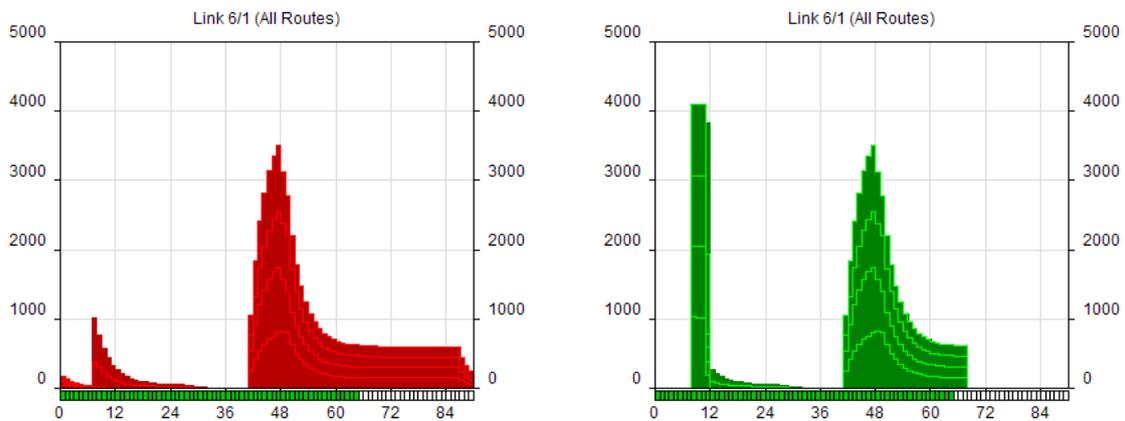
A Flow Profile graph for a single Route through a Link can be displayed as follows:

- Select the graph for the Link in question.

- Right-Click on the graph with the mouse. A pop-up menu will appear.
- Choose 'Show Route x Only' where x is the Route number of one of the Routes through the Link.
- The graph will show the Flow Profile for the individual Route through the Link.
- Add additional graphs for the Link changing each of them to show a different Route as desired.

### Showing the Individual Route Flow Components on a Single Graph

As well as splitting a Flow Profile graph into separate graphs for each Route the Flow Profile View can also show a single graph for the Link, as described above in 'Showing Inflows and Outflows Separately', displayed disaggregated by Route.



Each Route Flow Profile is shown as a separate 'layer' in the graph. The layered Route Flow Profiles cannot be shown on a combined inflow/outflow graph as the display becomes extremely complex and difficult to understand.

### Displaying a Graph Showing Route Flows as Route Layers

A graph can be displayed with Route Layers as follows:

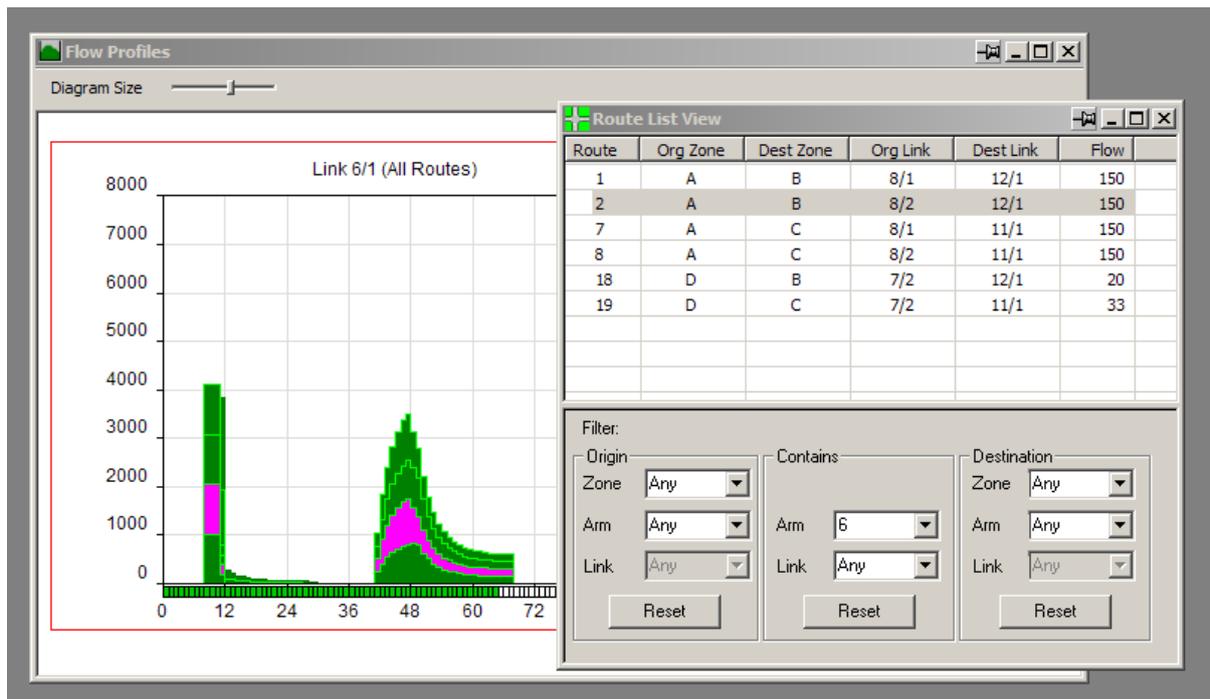
- Right click on a graph and choose to display either Inflows or outflows from the pop-up menu.
- Ensure 'Aggregate all Routes' is selected on the same pop-up menu and that the graph isn't showing a single Route Profile.
- Choose 'Show Route Components when Aggregated' from the pop-up menu.
- The graph will be shown with each Route Component as a separate layer.

## Highlighting a Single Route Layer

When a Link has many Routes it is sometimes difficult to determine which Route Layer is which in the graph. A Route Layer can be identified as follows.

- Ensure the Route List in the Traffic Flows View, the Junction Layout View and the Flow Profile View are all visible.
- Select a Route passing through the Link in the Route List.
- The Route will be highlighted in the Junction Layout View and the Route Layer will be highlighted in each of the Flow Profile Graphs.

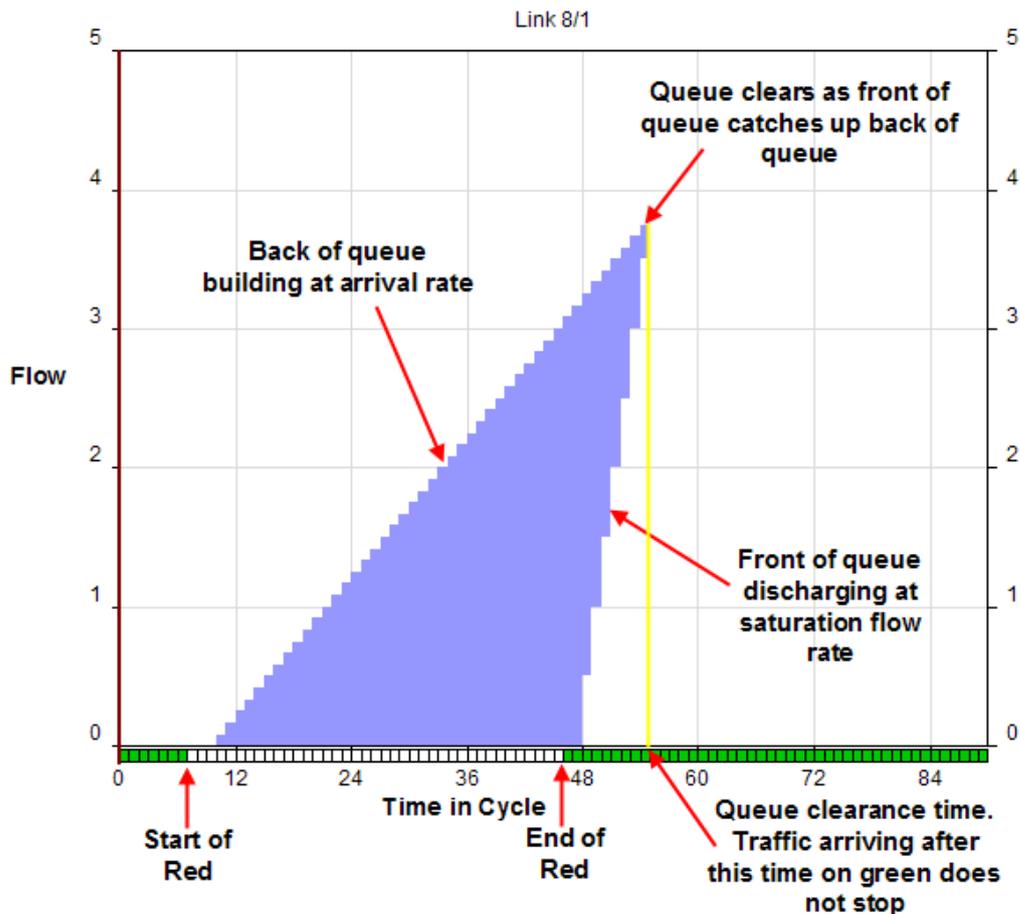
Highlighting Route Layers is very useful when examining the effects of platooning and working out which movements queue and which get good green progression.



### 3.17.2. Uniform Queue Graphs

Uniform Queue Graphs show the Uniform Queue on a Link over a typical signal cycle. It is important to understand that the graphs show only the Uniform Queue and do not include the random and oversaturated queue components which are calculated separately, not by the flow profiles. More information on the different queues and delays types is given in the modelling section.

Uniform queue graphs show the following information:



#### 3.17.2.1. Creating Uniform Queue Graphs

Uniform Queue Graphs are created as follows:

- In the Flow Profile View create a Flow Profile Graph for a Link as described above in 'Creating Flow Profile Graphs and Controlling their Layout'.
- Right click on the graph and choose 'Show Uniform Queue' from the pop-up menu.
- The Uniform Queue Graph displayed can be scaled, repositioned and deleted in the same way as Flow Profile Graphs.

Uniform Queue graphs cannot currently show the queue layered for different Route Flow Components on the Link as Flow Profile Graphs can do.

### 3.18. Error View

The Error View brings together all error and warning messages for the whole LinSig model. It acts like a checklist of errors requiring fixing avoiding the need to trawl the model looking for errors and reducing the likelihood of accidentally missing a problem which could be causing results to be incorrect.

The Error View can be opened by choosing 'Show Error View' from the Junction menu or by double clicking the Error Warning on the Status Bar at the bottom of the Main Window.

Location	Severity	Description
Flow Group (2006 Friday AM Peak)	Warning	Desired Flows do not match the Actual Route Flows.
Stage Sequence	Error	The Stage Sequence is invalid because it contains no stages.

The Error View shows three main pieces of information:

- **The Error's Location.** This describes where in the LinSig model the error occurs.
- **The Error's Severity.** This describes the consequences of the error. The two levels of severity are:
  - **Error.** An Error prevents results from being calculated until the error is fixed.
  - **Warning.** A Warning does not prevent results from being calculated but indicates something that LinSig thinks is suspicious and requires investigating. It is completely acceptable for a LinSig model to have warnings provided they have been checked and you have satisfied yourself that they do not affect the validity of results.
- **The Error's Description.** This provides a detailed description of the error or warning.

2/1	High Street Left	U	B	-	-	-	-	-	200	1800	-	-	-	-	-	-	-
2/2	High Street Ahead	U	B	-	-	-	-	-	600	1800	-	-	-	-	-	-	-
3/1	Park Street Right	U	D	-	-	-	-	-	200	1800	-	-	-	-	-	-	-
3/2	Park Street Left	U	C	-	-	-	-	-	400	1800	-	-	-	-	-	-	-
4/1		U	-	-	-	-	-	-	1000	1800	-	-	-	-	-	-	-
5/1		U	-	-	-	-	-	-	1000	1800	-	-	-	-	-	-	-
6/1		U	-	-	-	-	-	-	500	1800	-	-	-	-	-	-	-

Ready      No Results Due To Errors      **Errors Exist ! (Click Here To Show Error View)**

When Errors or Warnings exist in the Error View LinSig will highlight this by displaying a red or amber Error Indicator in the Status Bar at the bottom of the Main Window. The Error View can be opened by double clicking the Error Indicator.

### **3.18.1.1. Correcting Model Errors**

LinSig assists with correcting Errors by guiding you to the source of the Error whenever possible. Double clicking on an error will jump to the View or Dialog Box which LinSig thinks is the best place to fix the error. As some errors have complex causes, LinSig can not always work out the best location to fix the error for all errors, but can usually do so for the most common ones.

## 3.19. Animating LinSig Views

With LinSig V2.4 and above several of the LinSig Views can be animated to show dynamically how signal timings change and coordinate throughout a typical cycle. LinSig steps through a typical cycle showing the situation for each time step in a number of views.

The Views which can be animated include:

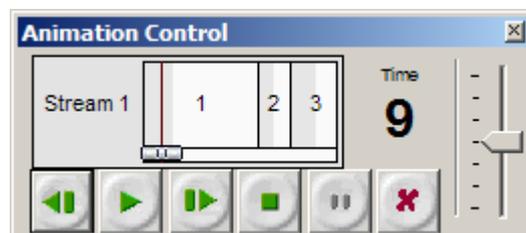
- The Junction Layout View animates the display of turning movements on green.
- The Phase View animates the display of running and non-running Phases.
- The Staging Plan View shows the running Stage at the current animation time.
- The Signal Timings View shows the current animation time within the cycle.
- The Flow Profile Graphs show the current animation time within the cycle.

The purpose of the animation is twofold:

- Provide an easy way for the engineer to visually check aspects of the model such as coordination.
- Provide a way of presenting a scheme to semi-technical users. Although the animation is obviously not as effective as some software packages capable of 3D photo-realistic visualisation it does provide a resource free method of demonstrating exactly how schemes will work to semi technical colleagues.

### 3.19.1. Controlling the Animation

The Animation is controlled using the Animation Toolbar. This is opened by choosing 'Animation Toolbar' from the LinSig 'View' menu.



The different sections of the Animation Control Toolbar are:

- **The Start/Stop/Pause buttons.** These respectively start the animation running, stop the animation, pause the animation and close the animation Control Toolbar.
- **The Step Buttons.** These allow the animation to be stepped forwards and backwards one second at a time.
- **The 'Time in Cycle' Display.** The central section displays the Stage Sequence for each Stage Stream and the animation's current time within the cycle. The time in cycle slider can be used to manually change the current animation time. Each Stage is shown in white with its interstage in grey.
- **The Animation Speed Slider.** The animation speed is controlled by the vertical slider to the right of the Animation Control Toolbar. The animation speed can be increased by sliding the slider down or decreased by sliding the slider up. The animation speed can be varied between real time and 40x real time.

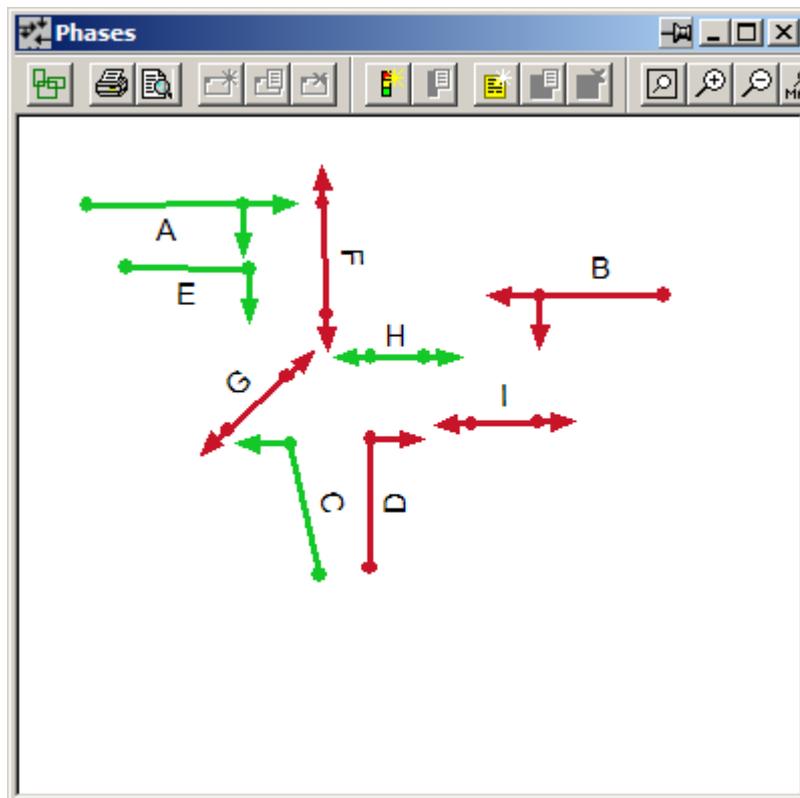
### 3.19.2. Viewing Animation in the Junction Layout View

The Junction Layout View displays the animation in several ways. These are:

- The Lane Turn Arrows are coloured red or green depending on whether the Lane's Link is running at the current point in the cycle.
- The Link Connectors are coloured red or green depending on whether a movement is allowed at the current point in the cycle.
- Any graphs appearing on the Junction Layout View display a time cursor at the current point in the cycle.

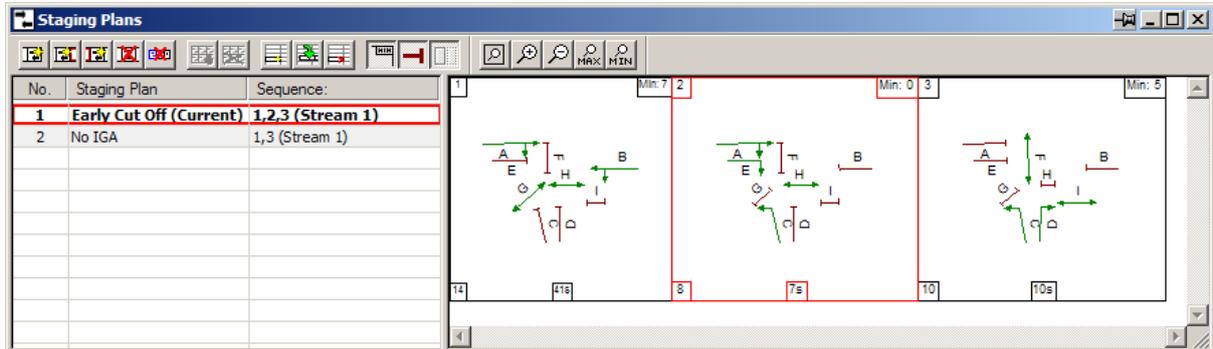
### 3.19.3. Viewing Animation in the Phase View

The Phase View displays the Phases configured in the Controller. When animation is active the Phases are shown as red or green depending on whether they are running or not at the current point in the cycle shown on the Animation Control Toolbar.



### 3.19.4. Viewing Animation in the Staging Plan View.

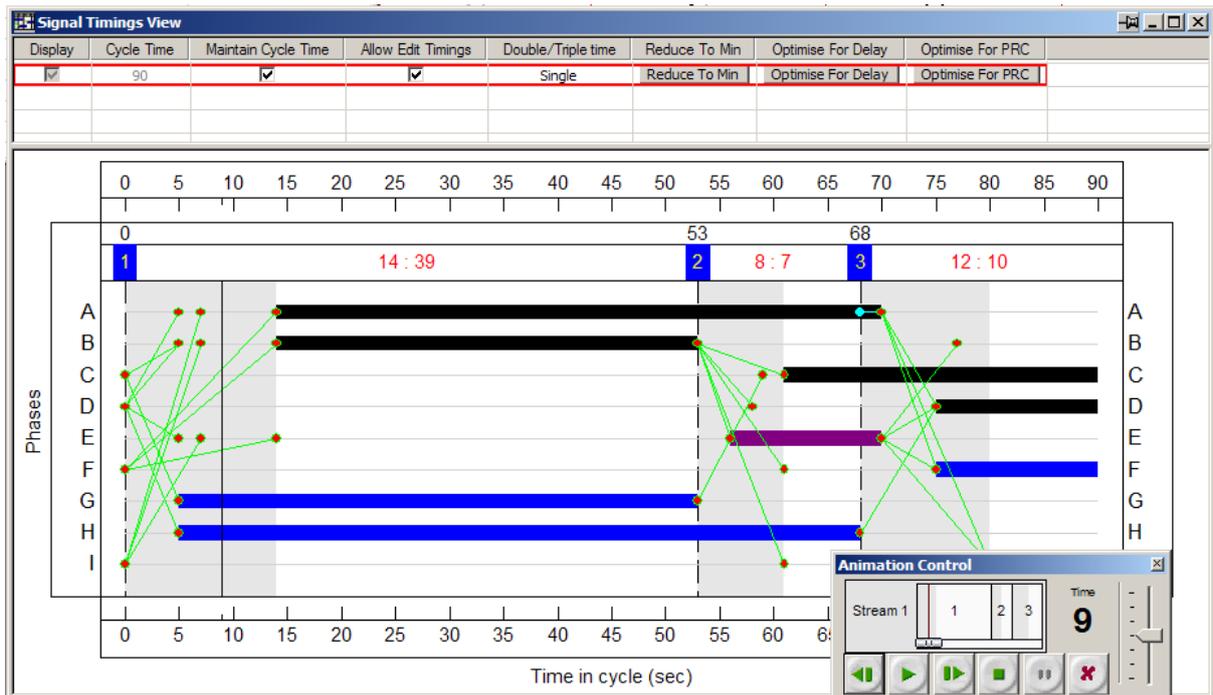
The Staging Plan View highlights the Stage running for each Stage Stream at the current animation time displayed in the Animation Control Toolbar.



If the current animation time falls in the interstage between two Stages both stages will be highlighted.

### 3.19.5. Viewing Animation in the Signal Timings View

The Signal Timings View shows the current animation time within the cycle. This makes it very easy to see where in the cycle the animation is, which Stage or Interstage is running and which Phases are about to start or terminate.



## 4. Modelling Background

This section looks at some aspects of the modelling in LinSig in more detail and provides background in a number of areas.

### 4.1. The Basic LinSig Traffic Model

LinSig uses Cyclic Flow Profiles (CFP) to model traffic moving through the Network. This section explains the theory underlying Cyclic Flow Profiles and how they are used to calculate queues and delays.

The concept of using Cyclic Flow profiles to model traffic behaviour is often misunderstood and assumed to be far more complex than it actually is. Although the model incorporates many details which allows it to model more complex situations with greater accuracy the underlying concept is relatively straightforward.

#### 4.1.1.1. Model Structure

A fundamental feature of the model is to represent traffic flowing along a section of road as a Link. Each Link represents a single, independent stream of traffic travelling between two junctions. Traffic enters the Link at its upstream end, from other Links, or from outside the Network, and leaves at its downstream end at a rate dependent on the Link's control, for example whether it is a signal or give-way Link. The rate at which traffic enters or leaves the Link varies over time with the model calculating queues and delays based on profiles of the arrival and discharge rate.

##### Time Slices

LinSig models the arrival and discharge profiles by splitting the profile into time slices, usually of one second. This fine resolution is necessary to model the detailed behaviour of traffic at a signal junction.

The amount of traffic arriving at a stop line during a time slice is dependent on the amount of traffic entering the Link from upstream Links within the time slice adjusted for the travel time on the Link.

The amount of traffic able to leave a Link during a time slice is dependent on how the Link is controlled. For example, a signal controlled Link will allow no traffic to leave during its red period but will allow traffic to leave at a maximum rate equal to the Link's saturation flow during its green period. The rate at which traffic can leave a give-way Link varies continuously dependent on the traffic flow in the current time slice on its opposing links.

The application of the above rules enables LinSig to calculate the traffic entering a link during a time slice and the traffic leaving the link during the time slice. If the queue length at the start of the time slice is known LinSig can then calculate the queue length at the end of the time slice.

##### Modelling a Longer Period

A longer time period can be modelled by chaining together a series of time slices to model the evolution of traffic flows into and out of the Link, and the queue on the Link over time. For each time slice the queue at the start of the time slice is assumed to be the same as the queue at the end of the previous time slice. As long as the flow profiles are known for traffic entering the network this method can be used to model a period of any duration.

#### 4.1.1.2. Cyclic Flow Profiles

The main problem with the above methods is the amount of computation required to model a long time period, for example one hour, with a sufficiently fine time-slice. This can lead to

large amounts of computation time and although computers have become much faster over the years the effort involved is still significant especially when it is necessary to rerun the model many times for optimisation purposes.

Cyclic Flow profiles have been used for many years as a way of reducing the number of computations necessary to model a junction. This method takes advantage of the fact that when all junctions in a network run at the same cycle time the pattern of traffic and queues on under capacity Links will be very similar during each cycle throughout the modelled period, that is, the flow and queue profiles on each Link will repeat cyclically. In its simplest case each cycle is assumed to be identical which can then be extrapolated throughout the peak hour.

For example if the total delay on a link in the typical cycle is 2.3 pcuh and the cycle time is 90sec and the modelled period is one hour, then as there are  $3600/90 = 40$  cycles in the modelled period; the total delay for the hour is  $40 \times 2.3 = 92$  pcuh. This also results in a reduction in the computing power required for calculating the flow profiles by 40 times.

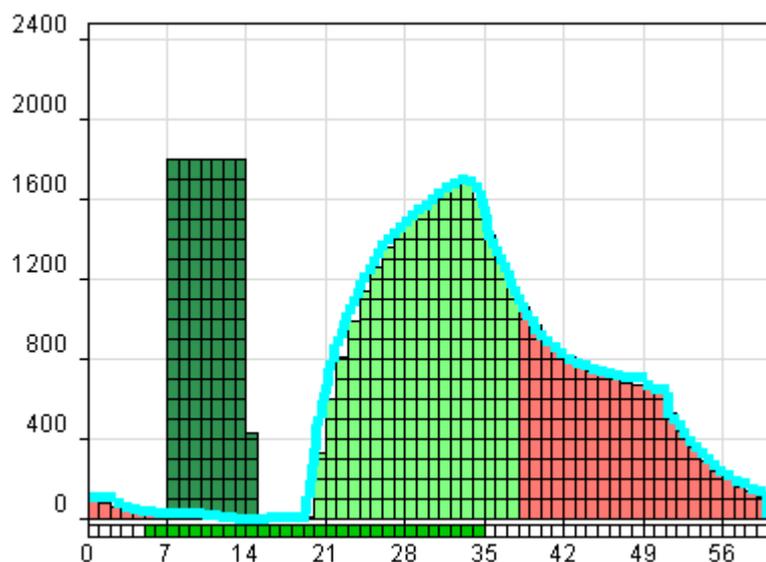
There are in fact three different cyclic flow profiles used for each link. These are:

- **Arrive / In Profile** – This represents the profile of traffic entering the Link throughout the cycle.
- **Accept Profile** – This represents the profile of traffic which is allowed to leave the Link in each time slice. The accept profile depends on the whether the Link is opposed.
- **Leave / Out Profile**- This represents the traffic leaving the Link in each time slice.

The Figures below show examples of each of the above profiles.

### Arrive Profile

The Arrive Profile shown above shows the arrival profile of traffic at the Link's stop line. This profile is derived from the Leave profiles from one or more upstream Links after they have been adjusted to allow for the time to travel between stop lines, and for the dispersion of the platoon whilst travelling along the Link.

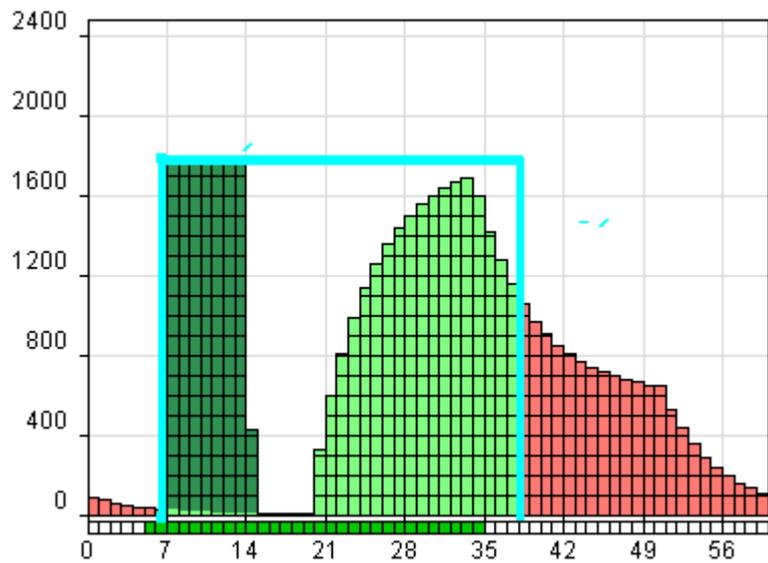


**Arrive Profile**

### Accept Profile

The Accept Profile shown below represents the discharge profile of a Link controlled by traffic signals. During the period the traffic signals are on green the Link can discharge traffic

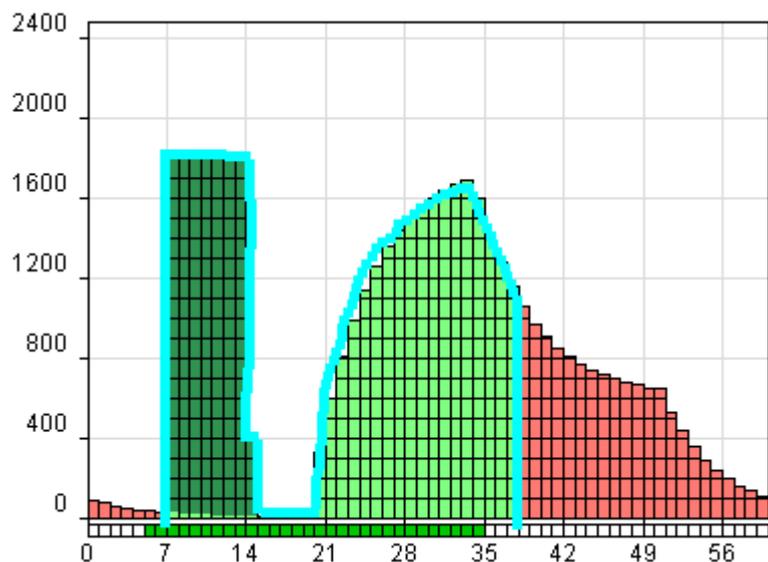
at a maximum rate equal to the Link's saturation flow. During the red period no traffic can leave the Link.



**Accept Profile**

**Leave Profile**

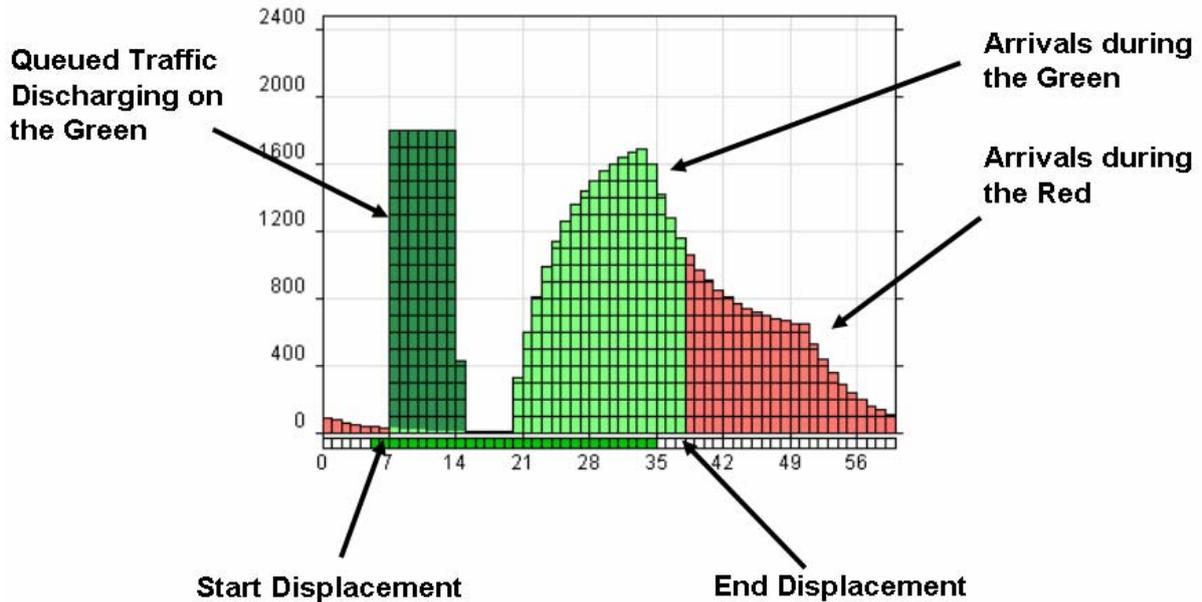
The Leave Profile shown below is calculated from the Arrive and Accept Profiles.



**Leave Profile**

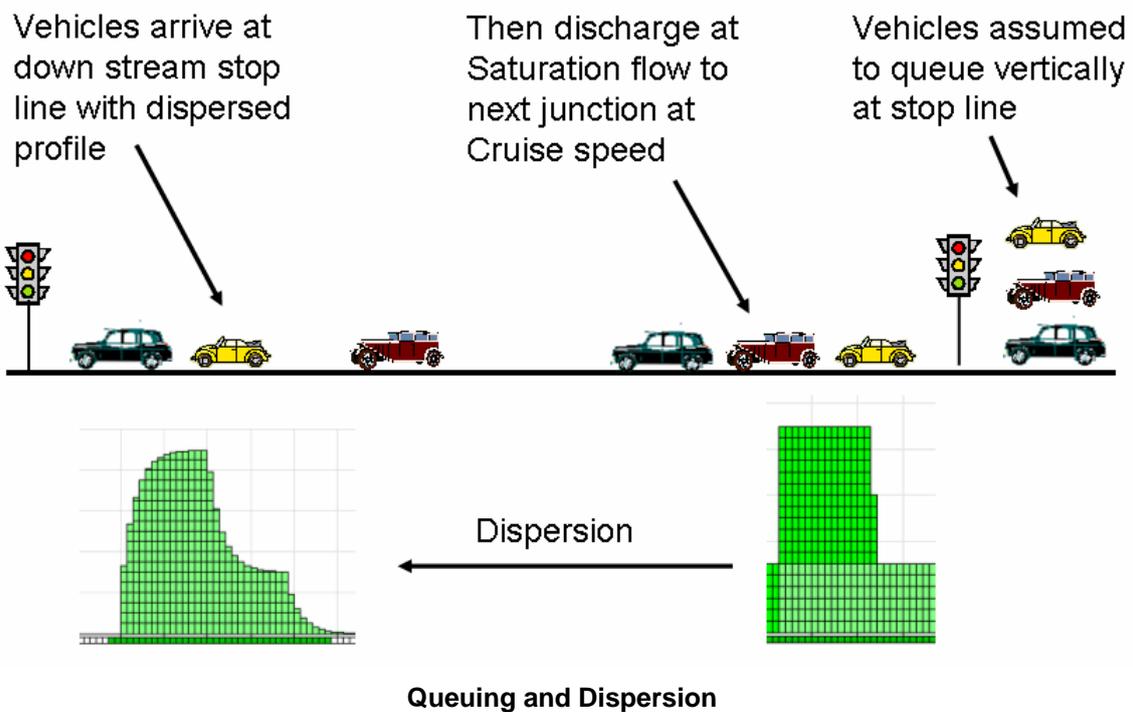
The initial peak of traffic at the beginning of the green period represents the queue formed during the red period leaving the link at the saturation flow rate. After the queue has discharged a short gap occurs when there is no traffic on the link to discharge before the next platoon of vehicles arrive and immediately leave the link as it is still on green. At the end of the green period the amount of traffic falls to zero as the signals are now red and further traffic arriving is forced to queue and wait for the next green period.

These different periods are identified below:



#### 4.1.1.3. Interactions between Links

The flow profiles for each link are calculated based on the traffic arriving from one or more upstream links. It is important to fully understand how traffic moving between links is modelled.



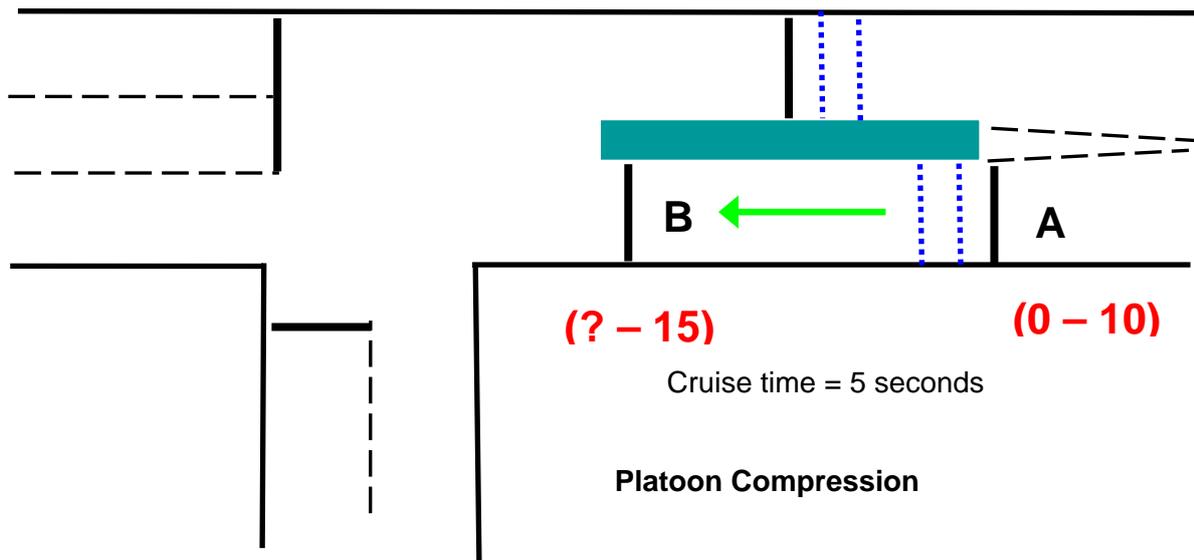
The above diagram illustrates a number of key points. These are:

- Vehicles queuing on a link are assumed to queue vertically at the link stop line. This assumption means that every vehicle travelling along a link takes the same cruise time to reach the stop line regardless of the length of the queue on the link. It also means that the simulated number of vehicles queuing at the stop line may be greater than the maximum number of vehicles that could be accommodated on the link.
- The profile of vehicles leaving a link (the Leave Profile) is used to calculate the Arrival profile at a downstream link's stop line. The first assumption above could allow this process to be carried out simply by assuming the Arrive Profile of a link is the same shape as the Leave Profile of the upstream link but displaced in time by the link's cruise time.
- In reality unless links are very short, platoons of traffic spread out as they travel along a link. The shape of the Leave Profile is therefore smoothed as it travels along the link to model the effects of platoon dispersion. The level of smoothing is dependent on the link length.
- In the case of very short links, platoon dispersion is negligible. In reality, another effect becomes more prevalent due to the assumptions made about vehicles either being at rest or travelling at cruise speed. This is known as Platoon compression.

### **Platoon Compression**

It is assumed that vehicles start from the stop line at the cruise speed when the signals turn green (or at least after the start lag). This assumption is perfectly valid over long links because traffic will start to disperse. However over a short link of say 40 or 50 meters, the start up time will effect when the first vehicle arrives at the second stop line. Conventional modelling techniques assume that the first vehicle starts at the cruise speed and crosses the downstream stop line after the cruise time has expired. In reality, this only happens to the last vehicle; the first vehicle will take longer because it is starting from rest. Whilst the starting displacement takes account of this at the first stop line, there will be no starting displacement at the second stop line because the vehicles are travelling at cruise speed (anticipating the green from the starting red/amber).

For Example, consider the situation below where the signals at A commence green at time 0 and run until time 10. If the cruise speed from A to B is 5 seconds, then it may seem reasonable to set the green time at B to be from 5 to 15 seconds. The last vehicle through A will be travelling at the cruise speed and will therefore just clear the stop line at B. However, the first vehicle at A will be starting from rest and the time it takes to get from A to B will be one or two seconds more. This means that the signals at B could start two seconds later and run from time 8 to 15, representing only 8 seconds of green. If this is modelled in a conventional way, the stop line on B will be shown to be overloaded even though this can be clearly seen to happen in practice. The way to overcome this is to set the traffic at B to have no starting displacement (since the traffic will already be moving when the signals turn green).



Hence, if the traffic at A is set to run green from 0 to 10 seconds with the usual start and end displacements of 2 and 3 seconds respectively, then the signals at B will need to be set at 7 to 15 with zero start displacement and 3 seconds end displacement. The effective green at both stop lines will be 11 seconds, giving the same degree of saturation.

Generally, the rule is that if you are coordinating the signals in such a way that the first vehicle arrives on an opening green (without needing to stop), then you can remove the starting displacement.

#### 4.1.1.4. Model Accuracy and Queue and Delay Calculations

At low and medium levels of flow on a link the above method is quite realistic and real life random variations in traffic do not greatly affect the overall levels of delay predicted by the model. However, it becomes increasing less accurate as flows increase as the assumption that each cycle is the same becomes less realistic. When the flow on a link is greater than its capacity this assumption is obviously incorrect as at the end of each cycle the queue will have permanently increased by the difference between the flow arriving in the cycle and the links capacity. Each subsequent cycle would then add a similar amount to the links queue, and as the flows are assumed to be the same for each cycle throughout the modelled period the queue will never discharge during this period.

This problem is resolved by taking advantage of the fact that the additional delay per cycle due to over-saturation on a link can be separated from the delay caused by transient queuing within the typical cycle. The oversaturated delay component is relatively easy to calculate using a mathematical formula. This is then added to the transient delay calculated from the cyclic flow profile of the typical cycle which is termed the uniform delay.

An attempt is also made to allow for the fact that when the degree of saturation on a link is around 80-100% the real life randomness of traffic flows on a link will cause the delay to be higher than the uniform delay. A random delay component is calculated using standard formulae and is added to the uniform and oversaturated delay to give the total delay on the link. In reality, traffic arriving at a stop line from an approach which has no signalled junctions will have a very high random component where as arrivals from within a dense network of signals will have a much lower random component. The random delay component in the calculations is assumed to be a combination of the two situations.

#### 4.1.1.5. Queuing

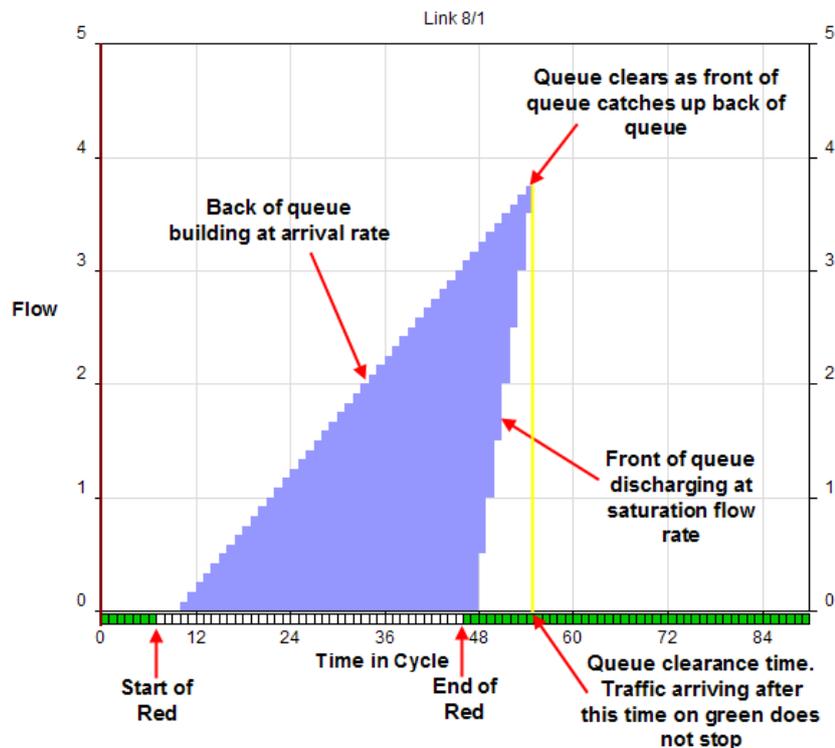
The queue lengths calculated by cyclic flow profile models are often misunderstood and it is important to understand the different queue components and how they are used to predict queue lengths.

Queues are inherently difficult to model accurately regardless of the quality or level of detail used in the model. Predicted queue lengths are extremely sensitive to small changes in input data. For example looking at a typical Link in a LinSig model with a flow of 600 PCU, its predicted queue at a degree of saturation of 90% is 19 PCU. Increasing the flow by 10% gives a degree of saturation of 100% and a queue of 29 PCU – an increase of over 50% in the queue length.

LinSig models queue lengths in three components similar to those used to model delay.

#### Uniform Queuing

The Uniform queue is the cyclic queue which grows and dissipates every cycle when the Link is below capacity. LinSig calculates the maximum queue in the modelled typical cycle and assumes this will be same for all cycles in the modelled period. This is why it is sometimes called the Mean Max Queue. The mean refers to the fact that it is the mean over a number of cycles of the maximum queue occurring each cycle. The maximum Uniform queue is the maximum length of the back of the queue as LinSig allows for the fact that vehicles are still joining the back of the queue after vehicles have started leaving the front of the queue. The maximum back of queue occurs when the discharging front of the queue catches up the back of the queue which usually will be lengthening more slowly. This is illustrated in the figure below.



#### Oversaturated Queuing

When a Link is oversaturated a residual queue remains at the end of the modelled typical cycle. The next cycle then adds to this queue by the same amount. This leads to a constantly increasing queue throughout the modelled period. For example, assume a Link's

arrival flow is 400 PCU/hr = 10 PCU/cycle for a 90s cycle and its capacity is 320 PCU/hr = 8 PCU/cycle and the queue is zero at the start of the modelled hour. The queue at the end of the modelled hour will be approximately  $(3600/90) \times (10-8) = 80$  PCU plus the maximum uniform queue. The mean queue will be approximately half the queue at the end of the hour that is 40 PCU.

### **Random Queuing**

When a Link has a degree of saturation less than 80% the uniform queue will be a good estimate of queuing. In cases where the degree of saturation is greater than around 110% the oversaturated case will also be fairly accurate, albeit sensitive to small changes or inaccuracies in input data. However, in most cases in traffic assessments the Links of most interest will be in the middle of these two zones in the 90-105% saturated range. In these cases in real life the queue will randomly clear some cycles and not clear other cycles leaving a residual queue. As the degree of saturation increases a higher proportion of cycles will result in a residual queue which will gradually accumulate over the modelled period. As LinSig only models a single typical cycle it is unable to directly model this random effect. LinSig therefore indirectly allows for this Random queuing using a standard formula to estimate the level of Random queuing on each Link assuming random arrivals. This is then added to the Uniform and Oversaturated Queues to give the Link's Total Queue. Although this technique allows the Link to be modelled using a single typical cycle reducing the modelling load it can lead to inaccuracies in some cases, for example, when a Link is in the middle of a dense network of closely spaced signal junctions arrivals will often be very tightly platooned and non-random, leading to an overestimate of Random Queuing. This is especially apparent on short Links which although highly saturated are completely coordinated with upstream Links, for example, a circulatory Link on a signal roundabout. Although the tight coordination allows all traffic through in the green time with no queuing the random delay predicts a queue even though the non-random behaviour of traffic in this case means no Random Queuing would occur in practice.

#### **4.1.1.6. Estimating Expected Flare Usage using LINSAT**

Short left turn only lanes are modelled in LinSig as a short lane attached to an adjacent long lane. The Expected Usage of the short lane will be affected by the fact that, depending on the proportions of ahead and left traffic, ahead vehicles may block left turners from entering the short lane. In the extreme case a number of ahead vehicles arriving early in the red period may prevent any left turners using the short lane.

This effect is modelled in LinSig by specifying the Expected Usage of the short lane to be less than its physical length. The Expected Usage can be calculated using LINSAT, a free utility available from JCT for estimating the Expected Usage of flares.

LINSAT uses a simple microsimulation of a single Link to estimate the average usage of a short lane based on an assumed set of turning proportions. The average usage is then used to calculate the Expected Usage of the short lane that should be entered into LinSig.

LINSAT is currently available to download free of charge from the JCT Consultancy Web site [www.jctconsultancy.co.uk](http://www.jctconsultancy.co.uk).

## 4.2. Give-Way Links in LinSig

LinSig models two main types of Give Way Link. These are:

- An un-signalised Give Way Link such as at a priority junction or a left slip.
- A Right Turn Link which gives way to opposing traffic for part of its green period.

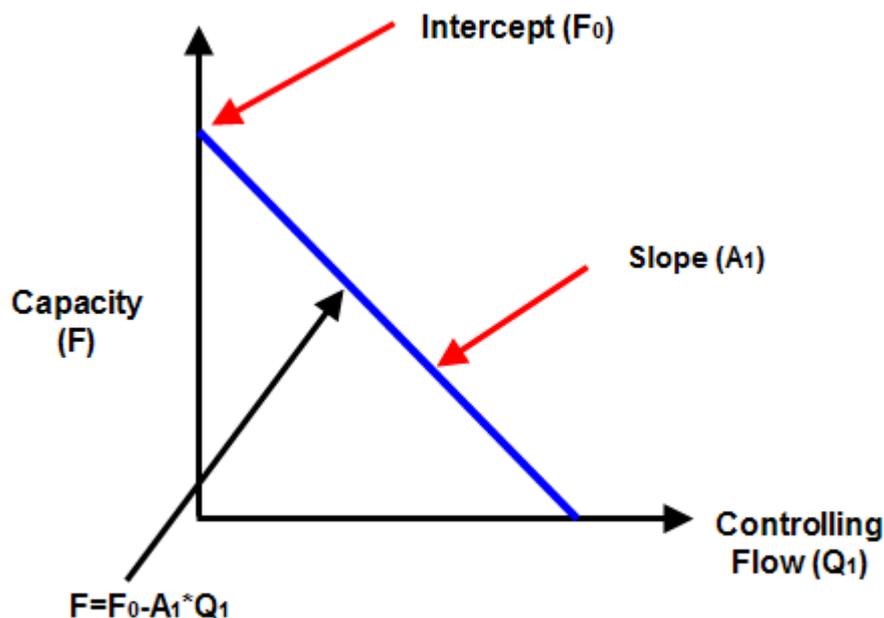
LinSig uses its give-way model to model the first scenario and uses the give-way model plus other Right Turn Model components to model the second scenario.

### 4.2.1. The LinSig Give Way Model

The capacity of an un-signalised Give Way Link is modelled using an assumed relationship between the capacity of the movement giving way and the rate of flow on Links opposing the Give Way Link. LinSig assumes a linear relationship as shown in the graph below. The linear relationship is specified using the following parameters:

- The Intercept  $F_0$  is the maximum flow when the Link is potentially opposed but no opposing traffic is present.
- The Slope  $A_1$  is a coefficient which specifies by how much the capacity is reduced by flow on the opposing Link.

LinSig allows for any number of opposing Links by allowing additional A parameters to be specified which relate to each opposing Link.



The above parameters can be interpreted in traffic terms as follows:

- **Intercept.** The Intercept is the maximum flow rate that could exit the give way Link if no opposing flow was passing the give way Link. It is important to differentiate this value from Saturation flow. Saturation flow values assume that the driver will not have to stop. The Intercept value assumes the driver may have to stop and will have to slow down to check for opposing traffic even if none is present. The Intercept value

will usually be much lower than a saturation flow value for a Link with the same geometry.

- **Slope.** The Slope relates to the effect the opposing flow has on the capacity of the give way Link. If a give way Links capacity drops rapidly as its opposing flow increases the slope will be higher.

LinSig uses the above relationship together with the flow on the opposing Link in each time slice to model the capacity of the give way Link in each time slice.

#### 4.2.1.1. Typical Values of Give Way Parameters

Typical values of Slope and Intercept for common situations include:

	Intercept	Slope
Give Way Controlled Left Turn	715	0.22
Right turn at Signals (Equivalent to Webster & Cobbe)	1440	1.09

The values for the right turn as signals are designed to give as close as possible correspondence with the Webster & Cobbe give way model used in LinSig V1.

#### 4.2.2. The LinSig Right Turn Model

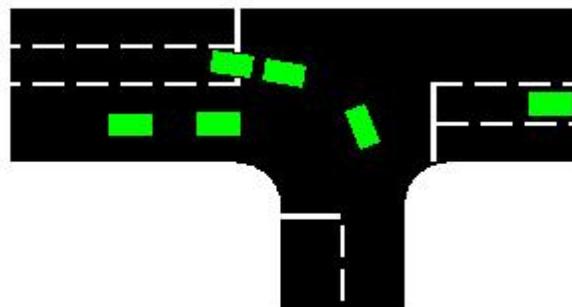
The majority of signal controlled junctions allow right turning traffic to turn in gaps across oncoming traffic when the signals are green. However, there are a number of additional issues to consider compared with a simple give way described above.

##### 4.2.2.1. Right Turn Capacity Components

The capacity of a right turning traffic stream is comprised of a number of components. These are:

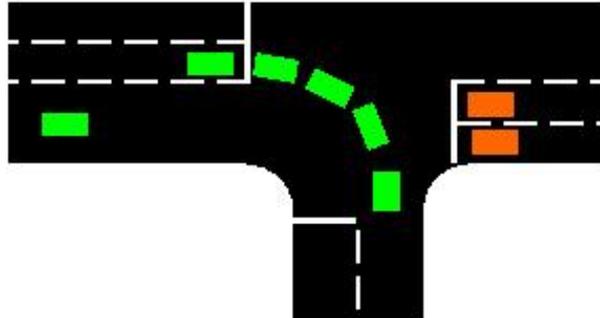
- Right turning traffic across gaps in the oncoming traffic
- Unopposed movement when opposing traffic is stopped
- Stationary traffic turning right during the intergreen.
- A bonus effect from vehicles waiting in the junction prior to the start of an indicative arrow.

##### Right turning traffic across gaps in the oncoming traffic



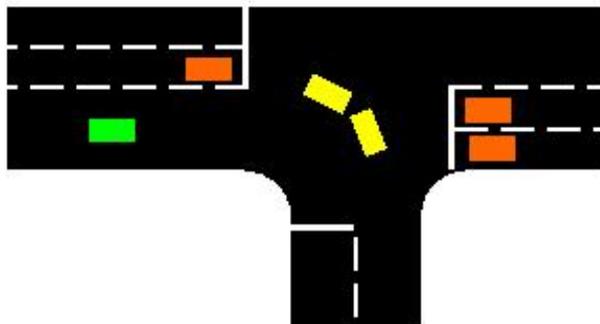
LinSig uses the give way model described above to model the capacity of the right turn during the period it is opposed by oncoming traffic. LinSig Version 1 used Tanners formula to calculate the capacity of the right turn during this period and similar results can be obtained in LinSig V2 by using 1440 for Intercept and 1.09 for slope in the give way model.

#### **Unopposed movement when opposing traffic is stopped**



The Capacity during the time when the right turn is unopposed, possibly whilst an Indicative Green Arrow is running, is calculated using the value of 'Saturation Flow when Unopposed' defined for the give way Link. This may be lower than the Link's Saturation flow if the right turners share the Lane with Ahead traffic as the Link's Saturation Flow relates to the Ahead movement.

#### **Stationary traffic turning right during the Intergreen**



Vehicles waiting in the junction at the end of the main road stage can turn right during the Intergreen. The Intergreen clearance depends upon the geometric nature of the junction. In the example above it is assumed that the two yellow vehicles stored in front of the stop line will clear during the Intergreen period. Any other vehicles waiting behind the stop line will wait for the next cycle.



### **Right Turn Move Up**

In order to ensure that right turning traffic has reached a position in the junction to accept a gap, a right turn move up parameter is specified. This is the time taken for a right turning vehicle to get from the stop line to the front position in the storage area. A rule of thumb is to estimate the move up time as 1 second for each PCU of storage space in front of the stop line.

### **Clear Conflict Times**

The Queue Clear time is used to ensure that right turning traffic cannot clear during the Intergreen until the last opposing vehicle has travelled from the stop line to the queue clear point.

## 5. Controller Background

This section provides additional information on various traffic signal controller issues. It is intended to assist with understanding controller issues affecting LinSig modelling and is not intended to replace a through knowledge of controllers and their configuration.

### 5.1.1. Phase Minimums

LinSig uses two types of Phase Minimum. This section explains how the minimums are defined and how they are used in LinSig.

The Phase Minimum types are:

- **Street Minimum.** The Street Minimum is the minimum time that a phase must be observed to run for on the street to comply with relevant standards. For a traffic phase the Street Minimum is usually 7 seconds.
- **Controller Minimum.** The Controller Minimum is the Phase Minimum stored in and used by the controller, and the LinSig controller model. Controller Phase Minimums are often the same as Street Phase Minimums but where phase delays are used they can be different. Controller minimums must always be greater than or equal to the Street Minimum.

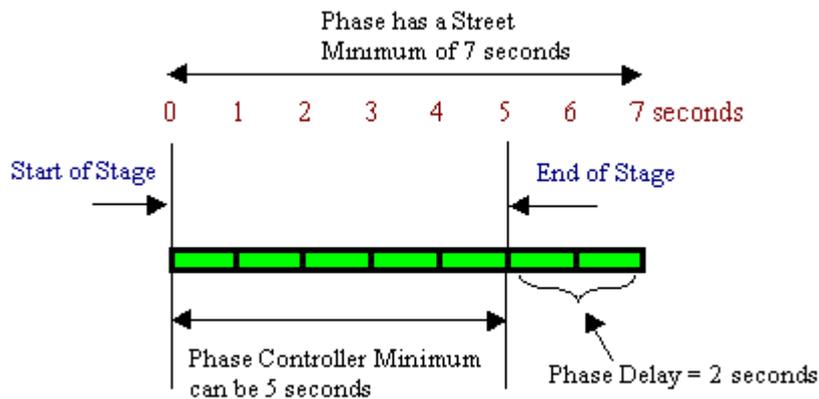
#### 5.1.1.1. Why are two types of Phase Minimum Required?

The two types of Phase Minimum are required because of the way traffic signal controllers use Phase Minimums and Phase Delays. Phase Minimums entered into the controller are always controller minimums. The controller will continue running a Phase and will not consider terminating it until its controller minimum has expired. The controller does not however take into account any Phase Losing Delays, so if a Phase has a Phase Losing Delay it will continue to run into the Interstage for the duration of the Phase Losing Delay after the controller minimum has expired. This means that for the stage changes involving a Phase losing delay the effective minimum will in fact be the controller minimum plus the phase losing delay. If the minimum used in the controller is the desired Street Minimum the effective minimum will be too long potentially causing inefficiencies.

#### 5.1.1.2. Compensating for Phase Delays

Where it can be guaranteed that the Phase Delay will occur on all possible stage changes it is possible to reduce the controller minimum below the Street Minimum to compensate for the Phase Delay.

In the example below, a Phase is required to have a Street Minimum (design value) of 7 seconds. The Phase however has the benefit of a 2 second Phase losing delay at the end of the stage. Hence, if the Controller Minimum is set to 5 seconds, the phase will run for at least 7 seconds on street. If the phase is given a 7 second controller minimum, then it will run for at least 9 seconds.



### 5.1.1.3. Calculating Controller Minimums

Like a real controller the LinSig Controller Model only uses controller minimums internally. LinSig will, however, allow you to specify the Street Minimums, converting them to controller minimums before they are used in the controller model. This allows you to use the street minimums from your design directly with no manual adjustments.

Whether the entered Phase Minimums are directly entered Controller Minimums or are Street Minimums which require conversion is specified in the Controller Information dialog which can be opened from the Junction menu.

If you choose to specify street minimums, LinSig will compute the lowest possible controller minimum that each phase could have such that the street minimum is not violated when running.

In the Example above, the phase delay enables LinSig to suggest that a Phase Controller minimum of 5 seconds is adequate. However, if we consider the situation on a change to a different Stage, upon which there are no phase delays, then a controller minimum of 5 seconds would be unsuitable. LinSig therefore computes the controller minimum with regard to all permitted stage changes, hence adding or deleting prohibited stage changes may well cause controller minimums to be changed.

### 5.1.2. Phase Intergreens

A Phase Intergreen is the period of time between the termination of the green signals for one phase and the beginning of the green on another phase. Intergreens should be calculated by locating conflict points on a plan and using the procedure detailed in TAL 1/06 to determine Intergreen durations. This is available from the DFT's web site. (Currently [http://www.dft.gov.uk/stellent/groups/dft\\_roads/documents/page/dft\\_roads\\_611509.pdf](http://www.dft.gov.uk/stellent/groups/dft_roads/documents/page/dft_roads_611509.pdf))

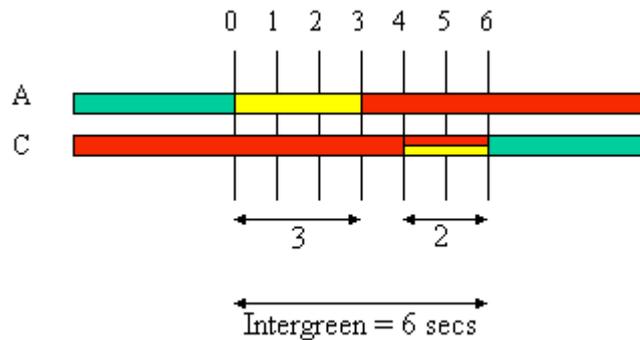
The following good practice points should be observed when using Intergreens:

- It is virtually never appropriate to simply guess Intergreens as 5 seconds as sometimes occurs in preliminary junction designs.
- It is important to carefully calculate pedestrian to traffic and traffic to pedestrian intergreens as they can often have a significant impact on junction capacity.
- Normally intergreens from a Filter Phase to other Phases should not be entered as the intergreen of the Filter's associated Full Green Phase is used instead. Specifying

intergreens between a back-to-back right Filter and its opposite opposing ahead movements can cause problems in the controllers design. This is due to the two Right Filters and associated Ahead Phases all waiting for each other to finish before completing the interstage, causing infinite loops in the interstage logic.

### 5.1.2.1. Intergreen Traffic Phase Aspect Sequence

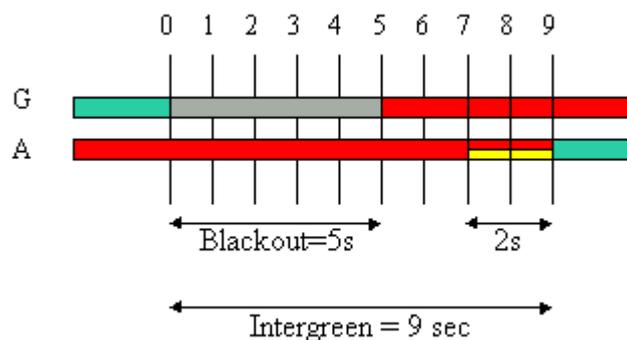
The signal sequence during a typical Intergreen is shown below. In this example the Intergreen A to C is 6 seconds.



### 5.1.2.2. Intergreen Pedestrian Phase Aspect Sequence

Blackouts are part of the intergreen between a pedestrian phase terminating and a traffic phase starting. They have no effect on the intergreen other than to replace part of the red man with no indication. Blackouts are not explicitly modelled in LinSig for Windows.

The signal sequence for a typical pedestrian intergreen is shown below. In this example the Intergreen between pedestrian Phase G and traffic Phase A is 9 seconds with a 5 second blackout period.



## 6. Reporting and Printing

LinSig can print information in three ways. These are:

- Directly printing the Junction Layout and Phase Views to a printer.
- Directly printing groups of Interstage and Flow Profile diagrams to a printer.
- Building a Report using the Report Builder. This can include both tables and graphics.

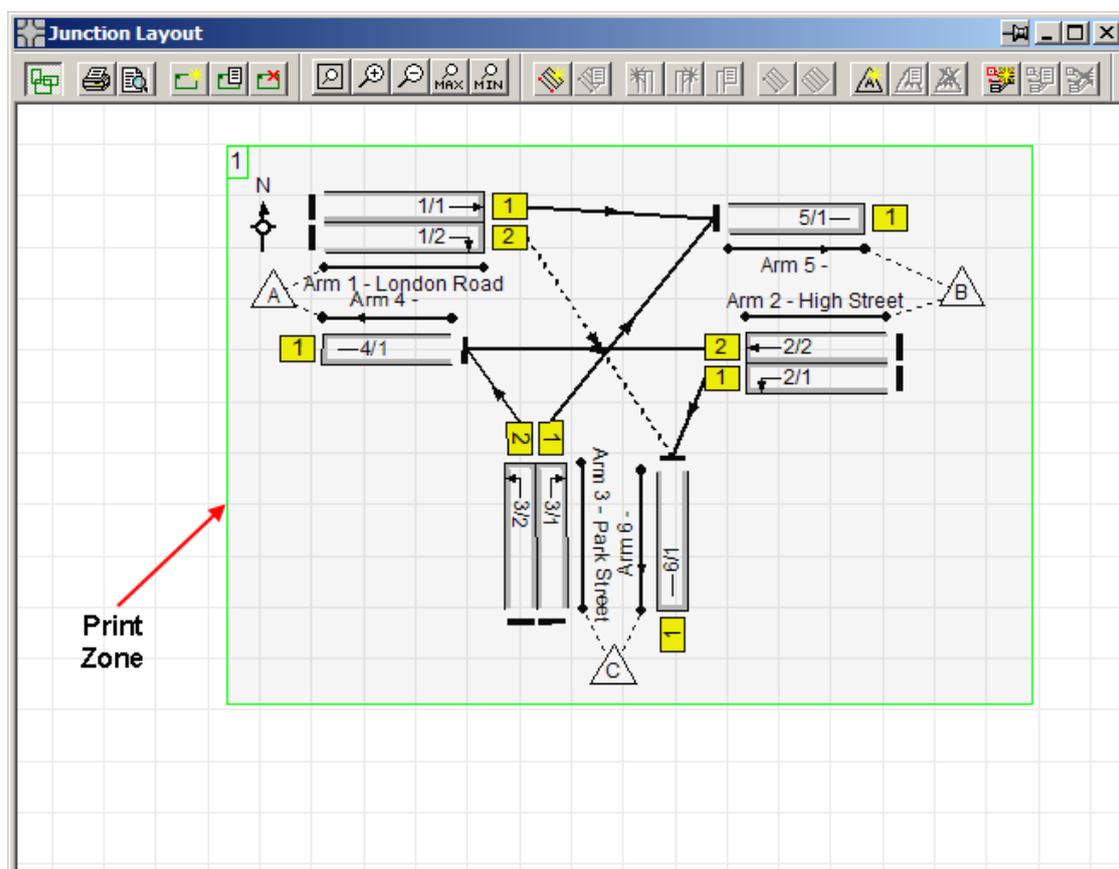
### 6.1. Printing Graphical Layout Views

The Junction Layout View and Phase View show the graphical layout of the junction and its controlling Phases. As these diagrams can often be larger than an A4 page LinSig allows them to be printed directly to a printer, possibly a large format printer, as well as being included in a LinSig Report.

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

Most Views can of course also be embedded in a LinSig Report and printed with the rest of the report via a word processor. This is covered in the Reporting section.

LinSig 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.



As shown in above a Print Zone is a rectangular area of a View 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.

### 6.1.1.1. Creating Print Zones

All creation and editing of Print Zones is carried out with the 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.

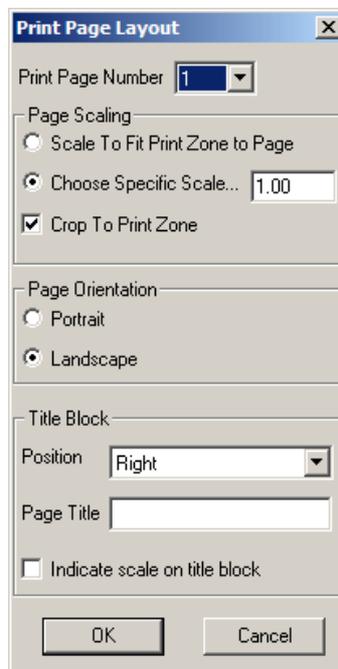
- To switch a View into Print Layout Mode choose 'Print Layout' from the File menu and choose 'Print Layout Mode' from the pop-out menu. Print Layout Mode can be switched off at any point by choosing 'Print Layout Mode' again. Alternatively the Print Layout button on the Views toolbar can be used.

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.

### 6.1.1.2. 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.



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 the View within its Print Zone to fit onto the current printer's default paper size, or can specify an absolute scale. Absolute scales are less flexible than scale-to-fit but are useful in ensuring each page's text and detail sizes are identical.
- **Page Orientation.** Allows each page's 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 in 'File Settings' which can be found on the File Menu. Each page can also have a separate Page Title defined.

### 6.1.1.3. Printing the View

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

- Choose 'Print...' from the LinSig File menu. LinSig 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.

## 6.2. Printing Multiple Interstage and Flow Profile Diagrams

The Multiple Interstage View and Flow Profile View allow multiple diagrams to be laid out and printed direct to a printer. They can also be included in a Report but direct printing allows a set of diagrams to be printed quickly without having to set up a specific Report.

Either View can be printed as follows:

- Open the View and create the diagrams required as described in the View's section in the View Reference.
- Choose 'Print...' from the LinSig File menu. LinSig will display the Print dialog box.
- If necessary, select the desired printer from the drop down list.
- Select the desired layout of diagrams on the printed page. LinSig will fit the layout of diagrams to the printer's current paper size.
- 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.

## 6.3. The LinSig Report Builder

The LinSig 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. LinSig no longer generates HTML reports due to the lack of flexibility of modifying and customising HTML based reports using standard word processing software.

### 6.3.1. Report Definitions and Templates

A LinSig Report is defined using a Report Definition. A Report Definition specifies information such as a Report's title, page size, and most importantly the layout of the Report. The Report's layout is specified as a sequence of Report Fragments. Each Report Fragment represents a Report item such as a table or diagram. LinSig includes over 30 different Report Fragments representing items such as Junction Layout Diagrams, Link input data tables, intergreen matrices, Stage diagrams and Link Results tables. A Report Definition can be as complex or as simple as desired and any number of different Report Definitions can be defined in each LinSig file. Any Report can be rerun at any point and will be completely regenerated using the current state of the LinSig model. This allows Reports to be defined once and quickly updated as a LinSig model evolves.

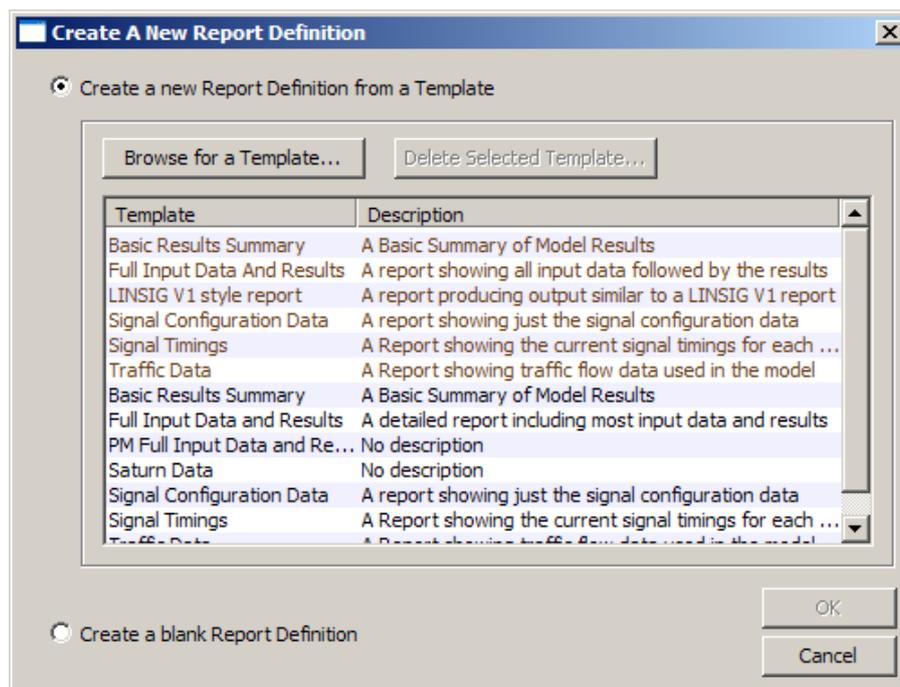
In many cases a Report Definition developed as part of one LinSig file could be useful in a number of LinSig files. LinSig therefore allows Report Definitions to be exported using Report Templates. Each Report Template is a file containing a detailed definition of the Report. This file can be imported into any LinSig model by any user to allow the Report to be reproduced based on the LinSig file it is imported into. LinSig is supplied with a number of default templates to get you started, however you may find it useful to develop a series of standard Report Definitions which can be distributed within your organisation to ensure a consistent Report design by all users.

### 6.3.2. Quickly Printing a Default Report

LinSig comes with a number of pre-built Report Templates which can be used to quickly run a report if you haven't yet had chance to develop your own Report templates.

To create a report based on a default template:

- Open the Report Builder by choosing 'Report Builder' from the LinSig Reports menu.
- Click the 'Add New Report Definition' button. The 'Create a New Report Definition Dialog Box' will open as shown below. The Standard Report Templates supplied with LinSig are shown in brown. Any User-Defined Report Templates are listed in black.

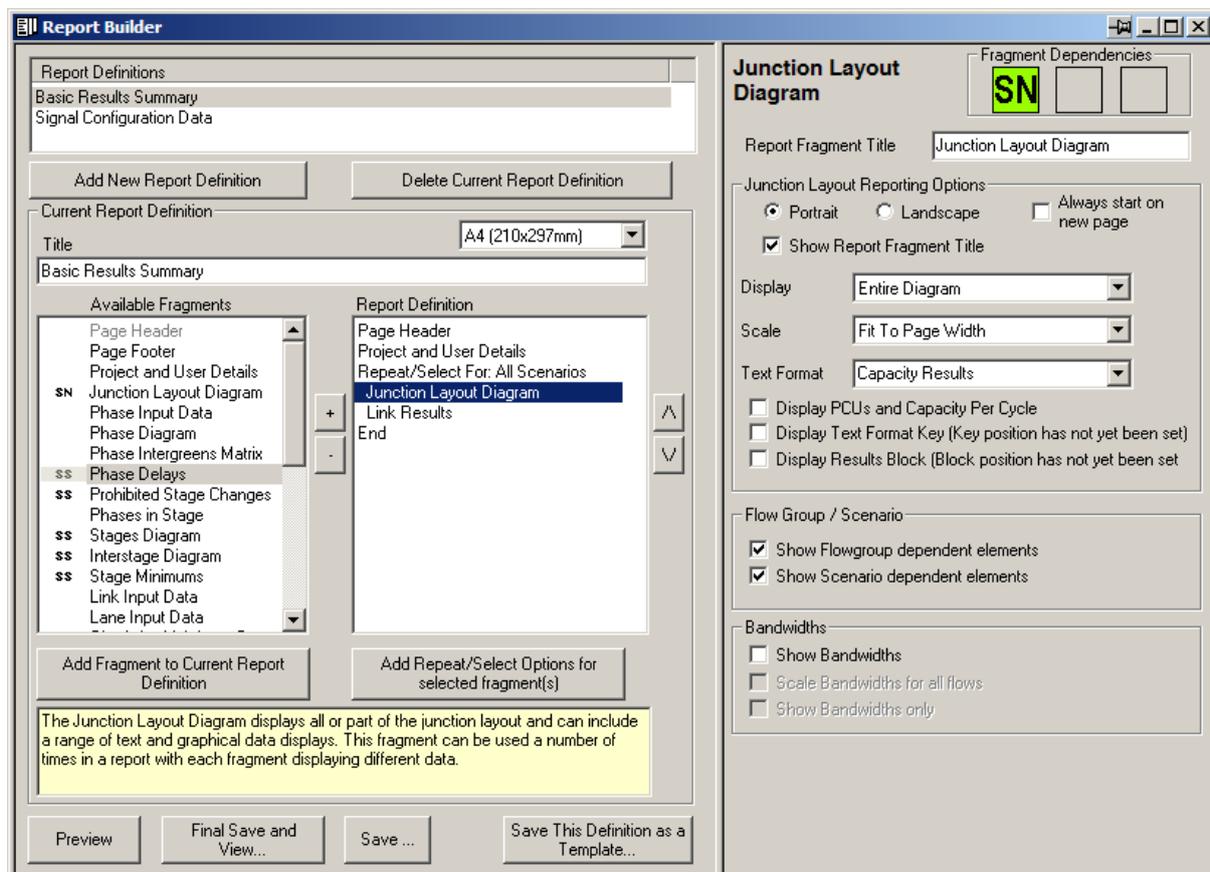


- Check that the 'Create a new Report Definition from a Template' option is selected.

- Select a Report Template from the list as desired and click the OK button.
- The Report Definition defined in the Template is loaded into the LinSig file and added to the file's Report Definition List. The Report's contents are shown in the Report Builder. Further information on changing the standard reports and working in the Report Builder is given later in this section.
- Click 'Preview...' at the bottom of the Report Builder. To avoid polluting your main data folders with lots of preview files LinSig saves a copy of the Report in the Windows temporary files folder and opens the Report in your default word processor.
- If desired the Report can be edited in the word processor before printing. As you previewed the Report you will need to specify where you wish to save the Report when saving it from your word processor.
- Alternatively you can click 'Final Save and View...' which allows you to save the file straight to the current LinSig data file's folder before opening the file in your default word processor.
- If you wish to rebuild the report at any stage you do not need to re-import the template. Simply select the Report Definition in the Report Definitions List and click 'Save and View This Report...'

### 6.3.3. Using the Report Builder

The Report Builder shown below 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 Report Builder consists of two main panels:

- **The Report Building Panel.** The left panel of the Report Builder provides tools to create new Report Definitions, manage Report Definitions and to define the content of the current Report Definition. The panel contains the following items:
  - **The Report Definitions List.** The Report Definitions List at the top of the panel lists the Reports defined in the current LinSig data file. The list allows a current Report to be selected. The current Report can then be run or edited using the rest of the Report Builder.
  - **The Report Page Size.** The Page size the Report's layout will be designed for.
  - **The Report Title.** The title of the current Report.
  - **The Available Fragment List.** The Available Fragment List lists all the fragments which can be added to the current Report Definition. Clicking on any Fragment in the list displays a description of the Fragment and its use in the yellow hint box immediately below the list. Fragments which can be repeated using Repeat/Select options are shown with an icon to their left describing the type of Repeat/Select options available. Any Fragments which cannot be added to the report for any reason are shown grey.
  - **The Report Definition.** The Report Definition lists the Report Fragments contained in the current Report Definition.
- **The Fragment Options Panel.** The right panel of the Report Builder displays options for the Report Fragment currently selected in Report Definition in the left panel. Each fragment has a different set of options with the number of options available reflecting the complexity of the fragment.

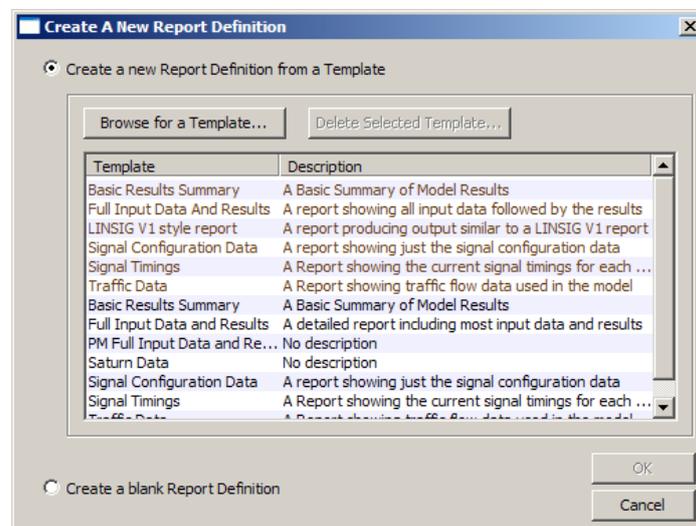
### 6.3.3.1. Managing Report Definitions

Each LinSig file can contains one or more Report Definitions which are used to define the layout of a LinSig Report. A Report can be produced or rerun at any time based on any of the Report Definitions.

#### Creating a new Report Definition

A new Report Definition can be created as follows:

- Click the 'Add New Report Definition' in the Report Builder. The 'Create a New Report Definition Dialog Box will open as shown below.



- A new Report Definition can be based either on a previously defined Report Template or can be created as a blank Report Definition.
- To create a new Report based on a Template, select the 'Create a new Report Definition from a Template' option. The Template List lists all of the Templates currently installed in either:
  - **The System Templates Folder.** The Templates in this folder are listed in brown. The folder is located at '[LinSig Install Folder]\Report Templates'. This is usually 'C:\Program Files\JCT Consultancy\LinSig 2\Report Templates'. This folder contains all the pre-defined Templates supplied with LinSig. Although there is no reason not to save your own Templates here you may find that your system's permissions have made the 'program files' folder read only.
  - **Custom Templates Folder.** The Templates in this folder are listed in black. The folder is located at '[My Documents]\LinSig Report Templates'. If desired the folder can be changed in the LinSig Program Options to a shared network drive to allow users to share Templates.

Select the desired template and click OK to create the new Report Definition from the selected Template and return to the main Report Builder.

- Alternatively select the 'Create a blank Report Definition' option and click OK to create the Report Definition and return to the Report Builder.
- The new Report Definition is listed in the Report Definitions List in the Report Builder.

### Deleting a Report Definition

A Report Definition can be deleted at any time by selecting the Report Definition in the Report Definitions List and clicking 'Delete current Report Definition'. This will only delete the Report Definition from the current LinSig file and will not affect any template files from which the Report Definition may have been created.

### Saving a Report Definition as a Template

A Report Definition can be saved as a LinSig Report Template at any point. This Template can then be used to add the Report Definition to any other LinSig file.

To save a Report as a Template:

- Click 'Save this Definition as a Template' in the Report Builder.
- Specify a description for the Template.
- The Template is saved as a .REP file which can be saved in any location but it is recommended to save most Report Templates in the Custom Report Templates Folder so LinSig can easily find them.

### 6.3.3.2. Editing a Basic Report Definition

Any Report Definition can be edited at any point to add or remove Report Fragments, to control how repeating fragments operate and to set display options for each fragment.

#### Adding Fragments to a Report Definition

A Fragment can be added to a Report Definition as follows:

- Select the Report Definition you wish to add the Fragment to in the Report Definitions List.
- Select the Fragment to be added from the Available Fragments List.

- Select the position where the Fragment is to be inserted in the Report Definition by selecting the Fragment in the Report Definition immediately before the desired insertion position.
- Click 'Add Fragment to current Report Definition' button or the '+' button between the Available Fragment List and the Report Definition. The Fragment will be inserted into the Report Definition.
- If the Fragment is shown in Red indicating the Fragment requires Repeat/Select options to be set, or the Fragment is inserted into the wrong place these problems can be corrected as described below.

### **Removing a Fragment from a Report Definition**

A Fragment can be removed from a Report Definition as follows:

- Select the Fragment to be removed in the Report Definition.
- Click the '-' button between the Available Fragment List and the Report Definition. The Fragment will be removed from the Report Definition.
- Once the Fragment has been removed all custom options for that Fragment are lost and would need to be reset if the fragment was reinserted into the Report Definition.

### **Changing the Order of Fragments in a Report Definition**

The Fragments in a Report Definition can be reordered to customise the layout of tables and graphics in the Report. The Fragments are reordered as follows:

- Select the Fragment to be moved in the Report Definition.
- Click either the up or down arrow buttons to the right of the Report Definition to move the selected Fragment up or down relative to other Fragments in the report.
- As the Fragment is moved it may turn red indicating in its current position it has Repeat/Select errors. This can be ignored unless occurring when the Fragment is in its final position in which case the Repeat/Select options should be corrected as described below.

#### **6.3.3.3. More Advanced Editing using Repeat/Select Options**

The Repeat/Select facility allows sophisticated control over how a LinSig report handles repeating fragments, for example, a table of traffic flows which is required to be repeated for a number of different flow groups. As well as allowing individual Fragments to be repeated the Report Builder also allows groups of Fragments to be repeated making the design of Reports very flexible.

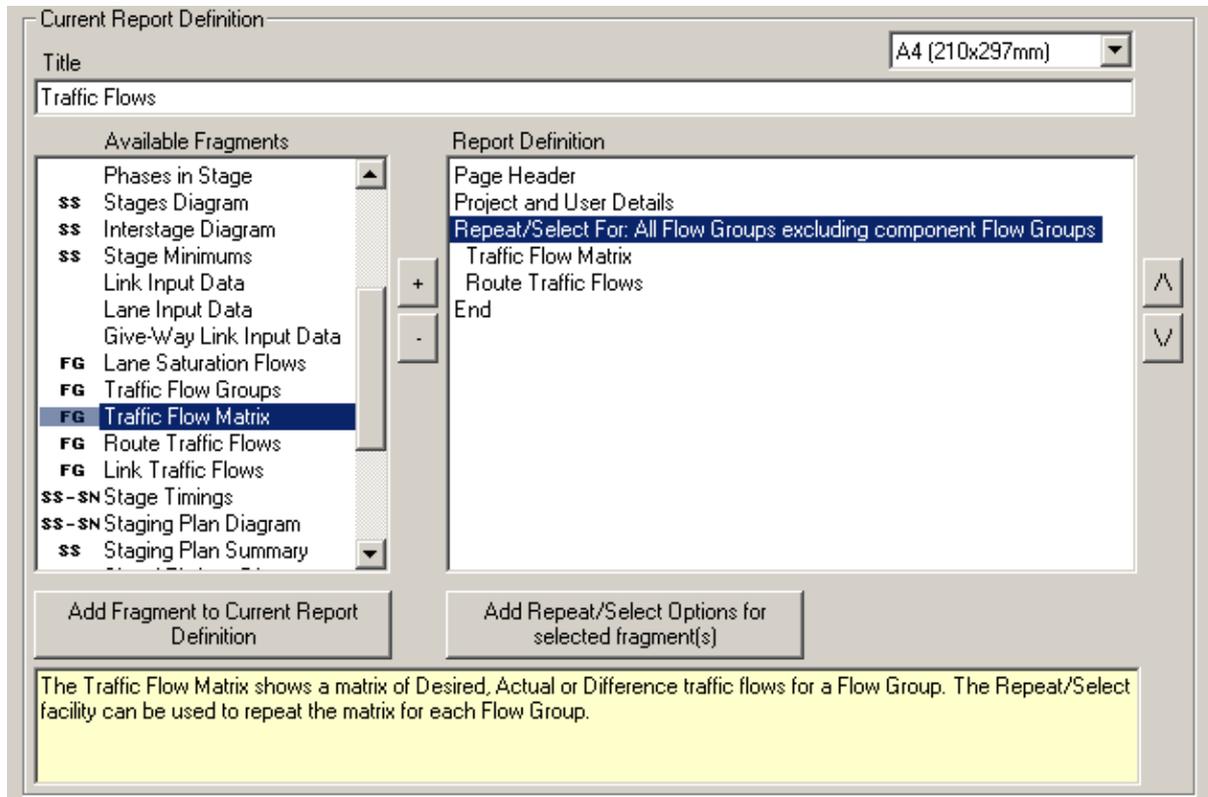
The repeating of fragments or groups of fragments are controlled using Repeat/Select blocks. A Repeat/Select Block encloses one or more fragments in the Report Definition. The Report Builder then repeats these fragments multiple times for a chosen criterion such as Traffic Flow Group or Stage Stream.

The following example illustrates the principle of Repeat/Select Blocks. In the example it is desired to have the following report layout:

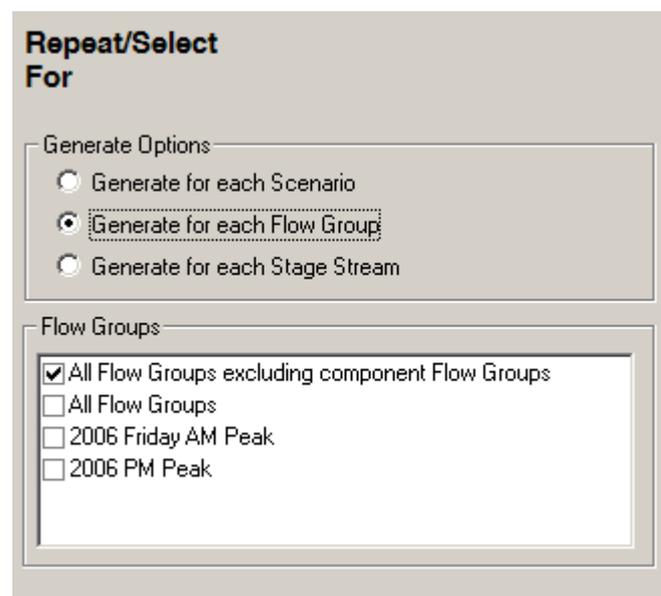
- Project and User Details Table.
- Traffic Flow Matrix – Flow Group 1
- Route Traffic Flows – Flow Group 1
- Traffic Flow Matrix – Flow Group 2
- Route Traffic Flows – Flow Group 2

- Traffic Flow Matrix – Flow Group 3
- Route Traffic Flows – Flow Group 3
- ...
- ... Repeat for all Flow Groups.

The following shows how this Report layout is defined in the Report Builder.



As the above example shows, the Report Definition includes a Traffic Flow Matrix fragment and a Route Traffic Flows fragment enclosed by a Repeat/Select Block. The Repeat/Select Block's options are shown below and indicate that the Fragments enclosed by the block will be repeated for All Flow Groups.



## Repeating a Block of Report Fragments

A block of Report Fragments can be repeated as follows:

- In the Report Builder's Report Definition List click the fragments you wish to repeat whilst holding the control (CTRL) key down. This will select multiple Report Fragments from the list.
- Click the 'Add Repeat/Select Options for selected fragment(s)' button below the Report Definition List. The Report Builder will try to determine what criterion to repeat the fragments for based on the fragment types being repeated. The repeating fragments are shown indented in the Report Definition List emphasising that they are part of the Repeat/Select Block.
- To review the Repeat/Select Options for the block select the Repeat/Select Fragment in the Report Definition List. The right pane in the Report Builder shows the Repeat/Select Options. If desired these options can be changed either to repeat the block based on a different criterion or to select only a subset of items, for example Flow Groups, for which to repeat the block for.

If necessary a Report Fragment can be nested within two or more Repeat/Select Blocks to repeat the fragment for combinations of two different criteria. For example the Stage Timings fragment needs to know both which Stage Stream and which Scenario to use and would therefore be enclosed in two Report/Select Blocks one repeating for Stage Stream and one for Scenario.

### Report Fragment Repeat/Select Criteria

Some Fragments which are based around a particular Flow Group, Stage Stream or Scenario must be located in a Repeat/Select Block so that the Report Builder knows which Flow Group etc. to base the Fragment on. Fragments which are required to be within a Repeat/Select block within the report definition indicate this by showing an icon to the left of the Fragment in the 'Available Fragments' list.

The icons have the following meanings:

<b>SN</b>	The Fragment must normally be within a Repeat/Select Block using Scenario as its Repeat criterion.
<b>FG</b>	The Fragment must normally be within a Repeat/Select Block using Flow Group as its Repeat criterion.
<b>SS</b>	The Fragment must normally be within a Repeat/Select Block using Stage Stream as its Repeat criterion.
<b>SS-SN</b>	The Fragment must normally be within two nested Repeat/Select Blocks one using Scenarios and the other Stage Streams as their Repeat criteria.

When a LinSig model contains only a single Flow Group, Stage Stream, or Scenario a Repeat/Select Block is NOT strictly required for that criterion as the Report Builder knows that only one item e.g. Flow Group is available to use with the Fragment. It is however recommended to include a Repeat/Select Block around the Fragment to avoid having to change the Reports if further items e.g. Flow Groups are added at a later time, or the Report Definition is saved as a Template.

Each Fragment which is dependent on any Repeat/Select options being specified indicates whether these requirements have been fulfilled using the Fragment Dependencies section at the top of each Fragment. This is illustrated below for the Stage Timings Fragment.

The screenshot shows the configuration for the 'Stage Timings' fragment. At the top, under 'Fragment Dependencies', there are three boxes: a red box with 'SN', an empty white box, and a green box with 'SS'. Below this is a text field for 'Report Fragment Title' containing 'Stage Timings'. The 'Staging Plans Data Table Reporting Options' section contains three options: 'Portrait' (selected with a radio button), 'Landscape' (unselected), and 'Always start on new page' (unchecked checkbox). There is also a checked checkbox for 'Show Report Fragment Title'. The 'Table Options' section features a spinner control for 'Maximum number of stages per table' set to the value 10.

The dependency indicators show which dependencies apply to this fragment and which have currently been fulfilled. In this case the Stage Timings Fragment requires a Scenario (SN) and a Stage Stream (SS) to be specified. The Stage Stream has been satisfied by including the Fragment within a Stage Stream Repeat/Select Block (or only a single Stage Stream exists) but the Scenario has not been satisfied indicating that a further Scenario Repeat/Select Block is required before the Fragment will work correctly.

When a LinSig model contains only a single Flow Group, Stage Stream or Scenario the dependency indicator will automatically be shown as green without the need to use a Repeat/Select Block for that criterion.

### 6.3.4. Viewing and Printing a Report

As LinSig 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 Microsoft Word Viewer can be downloaded from Microsoft's web site [www.microsoft.com](http://www.microsoft.com). You may need to consult your 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 LinSig 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 can be viewed in several ways using the buttons at the bottom of the Report Builder's left pane. These are:

- **Preview.** This creates the report file in a temporary location avoiding polluting the main data folder with a large number of report files as the Report is refined. If desired the Report can be edited in the word processor but if so it should be saved to a folder other than the temporary folder.
- **Final Save and View.** When you are happy with your Report use 'Final Save and View' to specify where the file will be saved before opening the file in your word processor. This allows you to ensure the file is saved in your preferred location.

- **Save.** This saves the Report file without viewing and is intended for the quick preparation of a number of reports for later checking.

## **6.4. Exporting Graphics**

Several LinSig Views can be exported to a number of graphics file formats to allow them to be used in engineering drawings or Desk Top Publishing (DTP) applications.

### ***6.4.1. Exporting a View to CAD***

A View 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.

### ***6.4.2. Exporting Views to DTP and Word Processors***

Many DTP packages support DXF and this can be used in this case. As a quicker alternative LinSig allows a View 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.

## 7. Examples

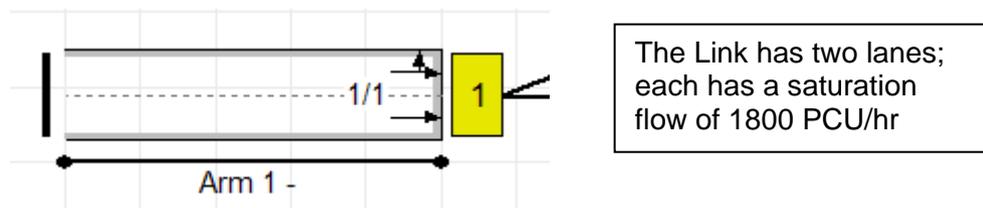
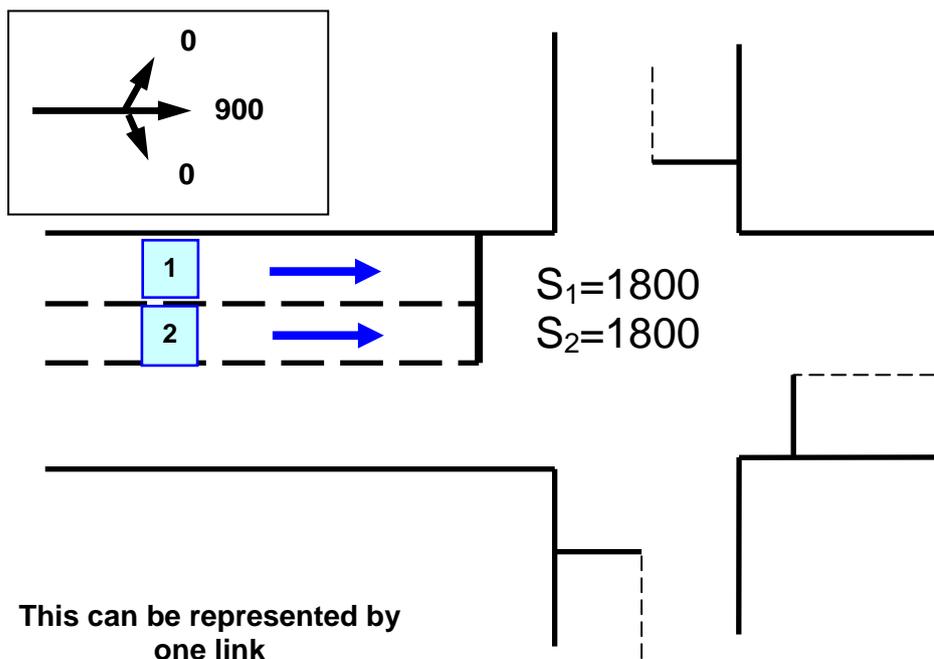
### 7.1. Link Structure Examples

This section provides a series of examples to illustrate how different junction geometries and traffic scenarios are coded into LinSig Link Structures.

#### 7.1.1. Example 1 – Grouping Lanes into a single Link

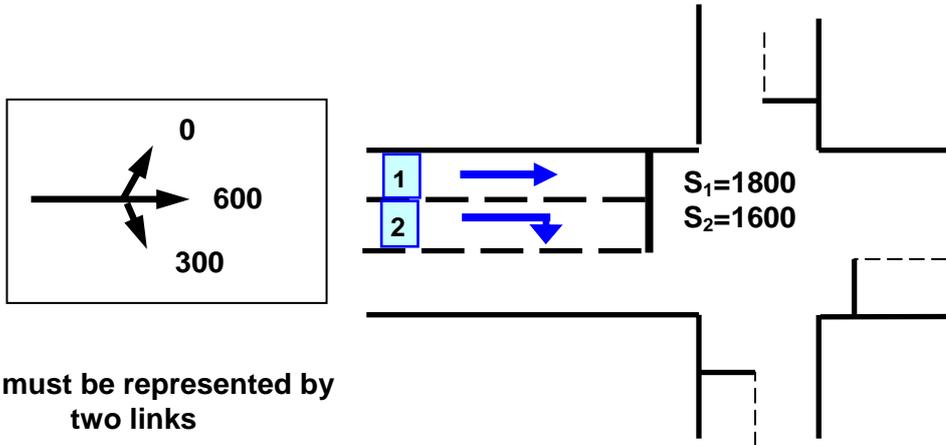
In the example below there are two lanes which receive an identical green signal, share a major ahead movement and there is no reason why queuing should not be equal in both lanes. The traffic can therefore be represented by a single link with a saturation flow of 3600 PCU/hr.

Note that in the case where there is a mixture of Ahead, Left and Right flows, the Ahead movement must be large enough to enable queue balancing. In this case, LinSig will assume 450 PCUs in each lane. If queue balancing is not likely to occur for all flow group scenarios, then consideration should be given to using a link per lane.

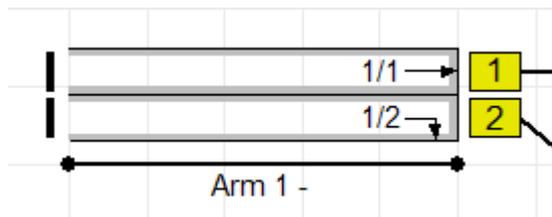


### 7.1.2. Example 2 – Exclusive Lanes

In the example below the offside lane is designated right turn only. Irrespective of the signal arrangement, there would be no shared movement and the lanes must be represented by separate links.



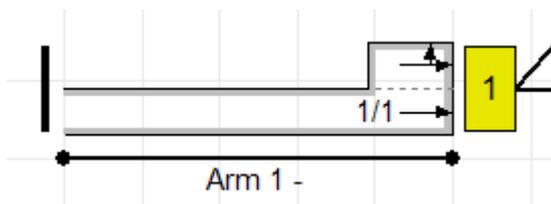
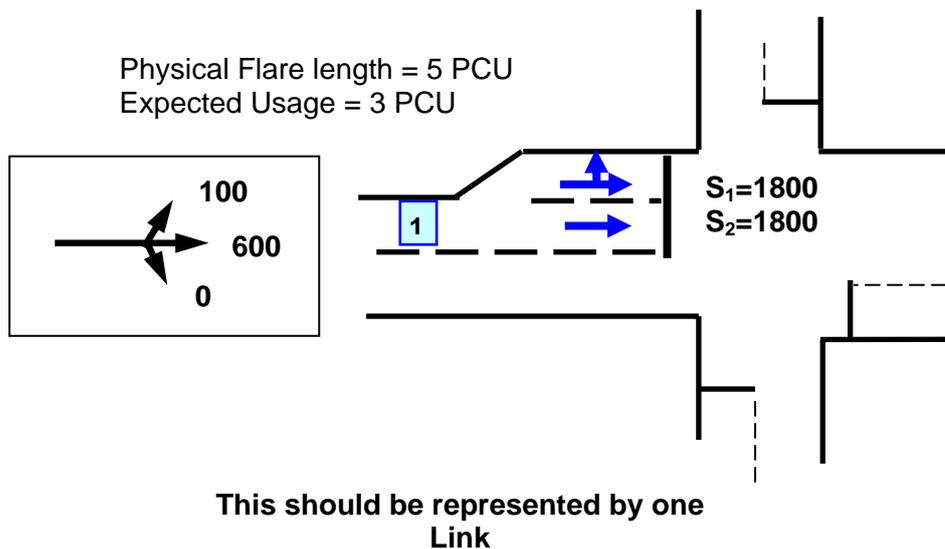
This must be represented by two links



Each Link has one Lane:  
 Link one has a saturation flow of 1800  
 Link two has a saturation flow of 1600

### 7.1.3. Example 3 – Flared Entry

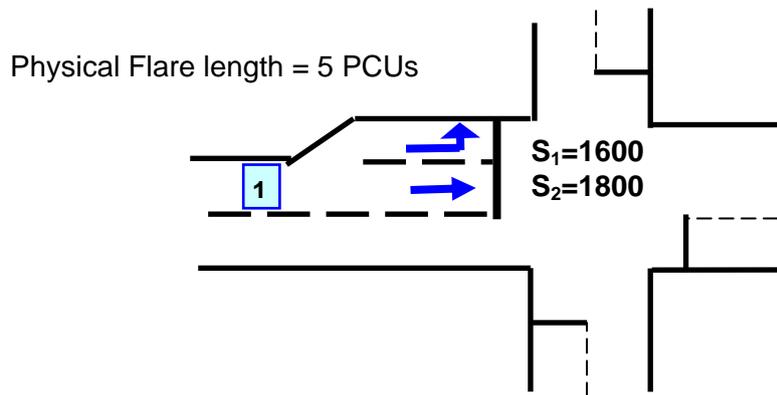
In the example below the Approach on Arm 1 is configured as having one infinitely long offside lane and one short nearside lane. The inside lane can hold 5 PCUs (this represents approximately 30 meters). The Lane length for the short Lane can be entered by unticking 'Infinitely Long Lane' in the Edit Lane dialog box. The physical length of the lane is entered in the 'Physical Length' box. In this case, due to driver behaviour, the usage of this lane is assumed to be only 3 PCUs per cycle. This is defined as the Expected Usage and can be entered either as a single Default Expected Usage applying to all Flow Groups or as a different value for each Flow Group. The Physical Length is not used for any calculation purposes but serves to give an indication as to how effective the flare is assumed to be. A Link should always have at least one infinitely long Lane – hence the Link must group both lanes together.



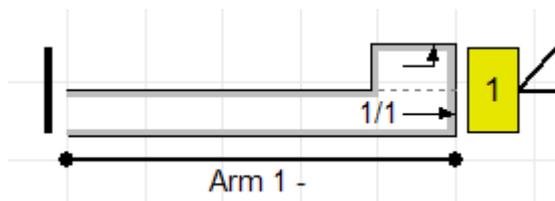
Lane Details		
Lane Length (Arm 1 Lane 1)		
<input type="checkbox"/> Infinitely Long Lane		
Default Expected Usage (PCU)		5.0
Flowgroup	Expected Usage	Default
2006 Friday AM Peak	3.0	<input type="checkbox"/>
2006 PM Peak	4.0	<input type="checkbox"/>
Physical Length (PCU) for reporting only		5.0

### 7.1.4. Example 4 – Left Turn Bay

The figure below shows an example where the inside lane is flared and is designated as an exclusive left turn lane (a bay). Again, this can be represented by one Link but in order to represent blocking, the utility LINSAT (available free of charge from JCT) will need to be used to calculate the Expected Usage of the flare. Depending on the relative traffic proportions, the Expected Usage of the flare could be reduced to one or even zero.

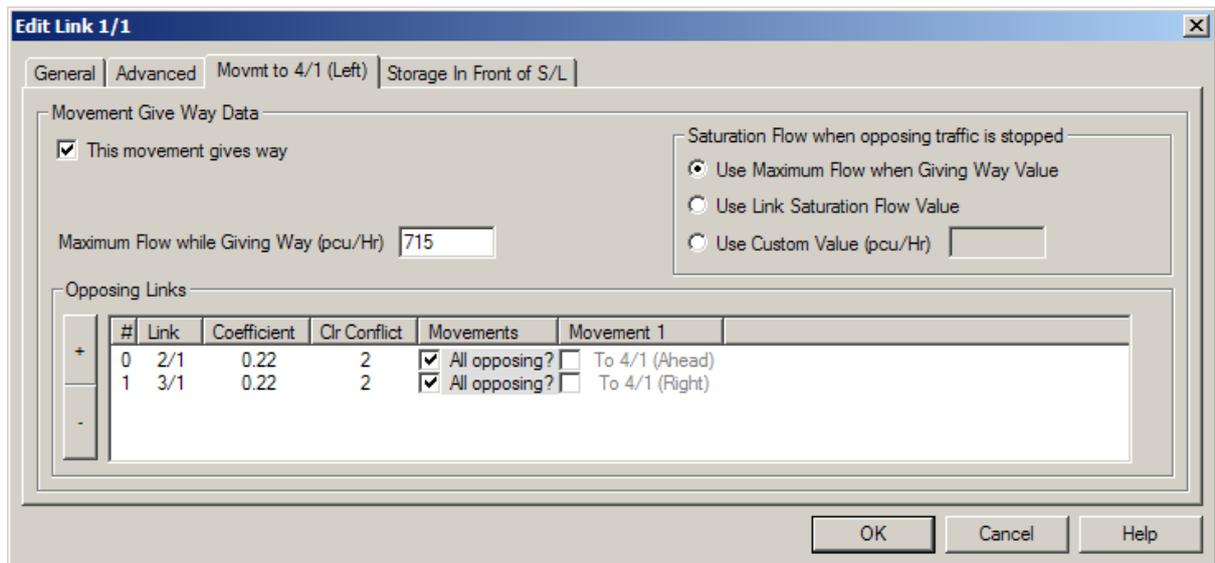


This should be represented  
by one link



The Expected Usage of the  
flare is determined by  
LINSAT



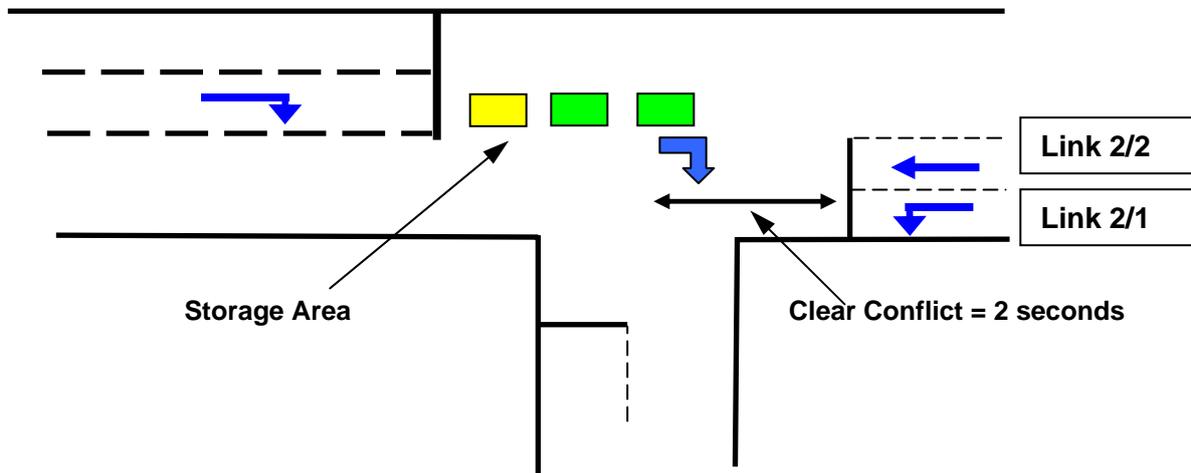


Points to note are:

- The section marked 'Sat flow when opposing Traffic is stopped' if left set to 'Use Link Saturation Flow value' will mean that during periods of the cycle where there is no passing traffic the rate of egress would be the link saturation flow which in this case would be wrong.
- In order for LinSig to know the time at which traffic from Link 2/1 and Link 3/1 is passing the give way entry a clear conflict time is added for each of the opposing Links. The clear conflict time relates to the cruise time for vehicles travelling between the stop line and the give way point for each movement.
- In this case there is only a single movement on each Opposing Link therefore the 'Opposing Movements' part of each Opposing Link entry is set to 'All Opposing' for each Opposing Link. In more complex examples only certain movements leaving each Opposing Link may oppose. In this case the 'All Opposing' box should be unticked and each individual movement's box ticked if it opposes.

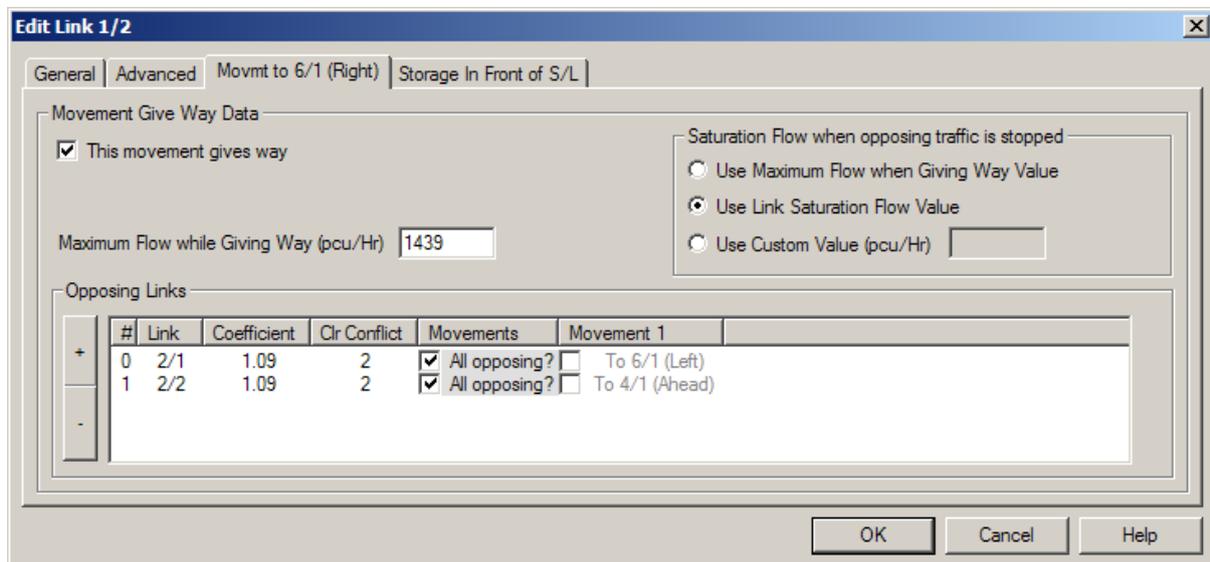
### 7.1.6. Example 6 – Right Turn Opposed Movement at Signals

A signal controlled junction where a right turn is controlled on a give-way basis (opposed). In this example, the right turners must give way to two movements (link 2/1 and link 2/2). It is assumed that three right turners can store in front of the stop line and that two right turners will clear during the Intergreen. The Right Turn Factor is assumed to be 0.5.



The mechanism of what happens with respect to the right turning traffic is directly dependant on the method of control. However, the parameters entered into LinSig are the same and LinSig uses them as appropriate depending on the method of control used.

The above parameters are entered in the 'Movement' and 'Storage in Front of Stop Line' tabs of the right turn Link's Edit Link dialog box.



Points to note on the Movement tab include:

- In this case there is only a single movement tab as all the traffic on the Link turns right. There is therefore only a single movement – the right turn - leaving the Link.
- The give way parameters used are 1439 for the 'Maximum Flow when giving way' (sometimes known as the intercept) and 1.09 for the 'Coefficient' for each Opposing

movement. These values are chosen to give a similar right turn give-way capacity relationship as used in the Webster & Cobbe method in LinSig V1.

- The 'Saturation Flow When opposing traffic is stopped' section is set to 'Use Link Saturation Flow'. This reflects the fact that in this case when the opposing traffic is clearly stopped (for example when a right turn IGA is running) traffic on the right turn will run at a much higher saturation flow equal to the Link's main Saturation Flow defined by the Link's Lanes. This is due to right turning traffic not needing to pause and check for oncoming traffic.
- Clear Conflict times of 2 seconds have been entered for each of the Opposing Links.

As this Link includes Storage in front of the stop line the 'Storage in Front of Stop Line' tab is also used to enter the Link's properties:

The screenshot shows a dialog box titled 'Edit Link 1/2' with a close button (X) in the top right corner. The dialog has four tabs: 'General', 'Advanced', 'Movmt to 6/1 (Right)', and 'Storage In Front of S/L'. The 'Storage In Front of S/L' tab is selected. Inside the dialog, there is a text box that says 'This is a signal-controlled Right Turn giving way to oncoming traffic.' Below this, there is a checked checkbox labeled 'Does the link have Right-Turn Storage in front of the stopline?'. There are four input fields: 'Right Turn Storage in Front Of Stopline (PCU)' with the value '3.00', 'Right Turn Move Up (s)' with the value '3', 'Right Turn Factor' with the value '0.5', and 'Max Right Turns In Intergreen (PCU)' with the value '2.0'. There is also a checked checkbox labeled 'Auto-Calc Using Storage'. At the bottom right of the dialog are three buttons: 'OK', 'Cancel', and 'Help'.

Points to note on the 'Storage in Front of Stop Line' tab include:

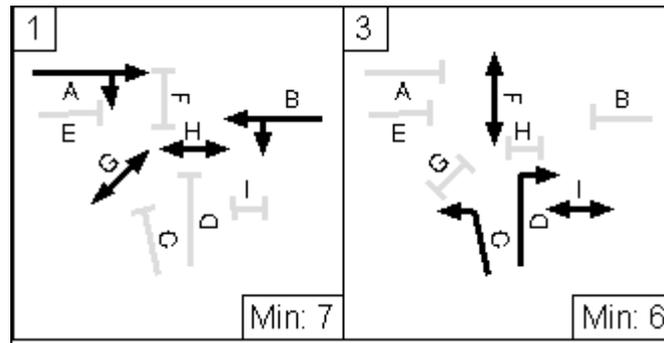
- The 'Does the Link have Right-Turn Storage in front of Stop Line' box is ticked indicating this Link is a Right Turn Link with Storage in front of the Stop Line.
- The Right Turn Storage, the Maximum Turns in the Intergreen and the Right Turn Factor are entered as specified above.
- The Right Turn Move-up Time is set to use 'Auto Calc' to estimate the Right Turn Move Up time from the Right Turn Storage.

### 7.1.6.1. Signalling Conditions

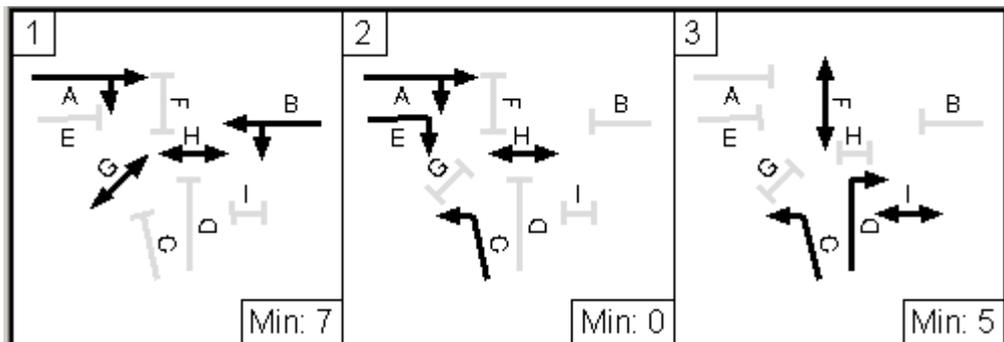
LinSig will calculate the capacity of the right turn according to the method of control set in the Staging Plan. For example, the diagram below shows a simple stage arrangement where there are no special opportunities for right turning traffic to turn except during gaps in Stage 1 and during the Intergreen at the end.

The capacity is simply calculated as:

***The number turning in gaps +  
the number turning during the Intergreen***



If the method of control is modified to provide an early cut off stage (indicative arrow) as shown below, then right turners can turn in gaps during Stage 1, at full saturation flow during Stage 2 and will also receive a bonus for the number of vehicles stored in front of the stop line prior to Stage 2 starting.



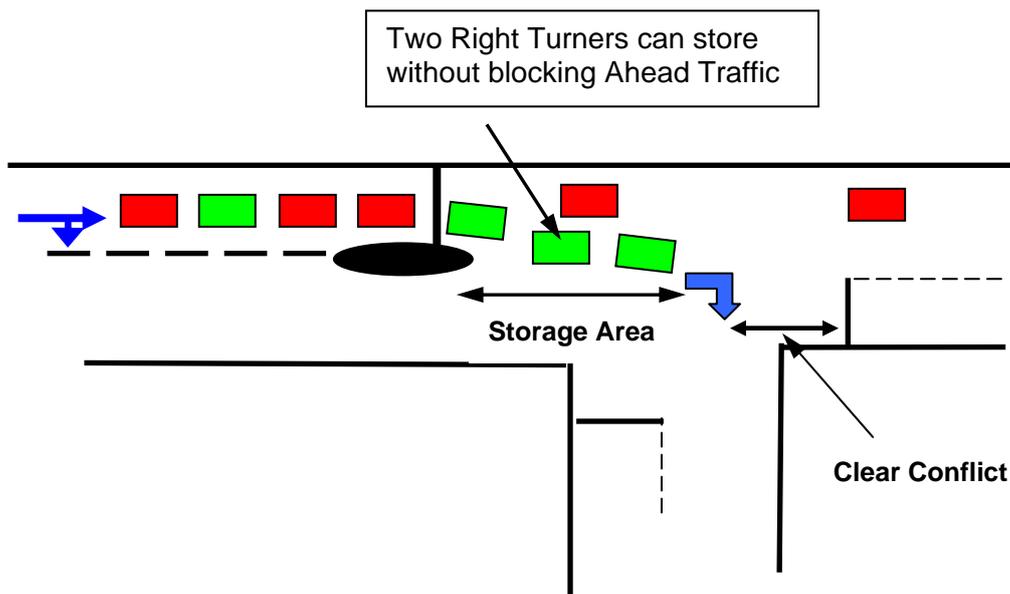
The capacity is simply calculated as:

***The number turning in gaps +  
the number turning during the Indicative Arrow +  
the bonus for storage in front of the stop line (= 3 in this case)***

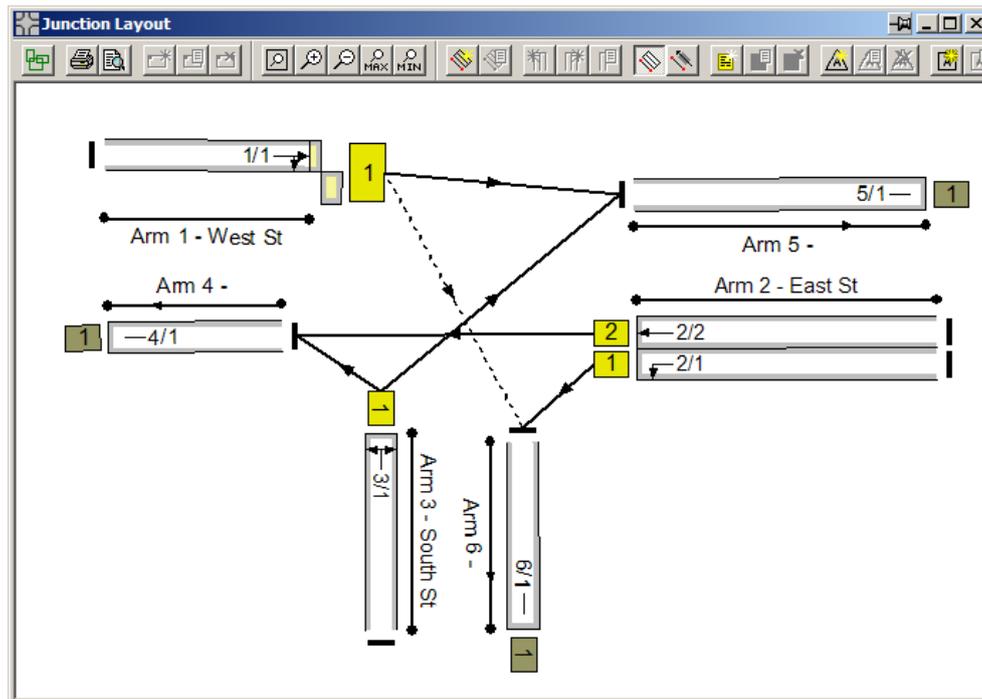
### 7.1.7. Example 7 - Mixed Right Turn Opposed Movements and Ahead Traffic in a single lane.

A new feature in LinSig Version 2 is the ability to handle a mixture of opposed and unopposed traffic in a single lane. Previously, in the case of a single lane where a right turning flow is very low (i.e. not likely to be a capacity issue) the right turning traffic could be added to the ahead movement and thereafter ignored. In LinSig V1 this was considered adequate because by adding the right turn to the Ahead traffic, the capacity calculation at the stop line was correct. However, in LinSig V2, the ability to model more than one junction and the fact that flows are now entered as an OD matrix means that it is necessary to model all right turning flows no matter how small. Whilst this may seem like more work, it will make the modelling easier and make each model more adaptable and robust in dealing with varying traffic flow data.

A critical factor in modelling capacity for situations which have a mixture of ahead and right turning traffic in a single lane is whether or not right turners at the front of the queue block the Ahead vehicles. LinSig now has a unique feature which allows this to be modelled. The area in front of the stop line is known as the Storage Area and represents the number of right turners that can wait in front of the stop line. The number of PCU which can store before blocking is used to specify how many of these waiting PCU do not block the Ahead traffic whilst waiting.



The LinSig Model Link Structure used to model the above is:

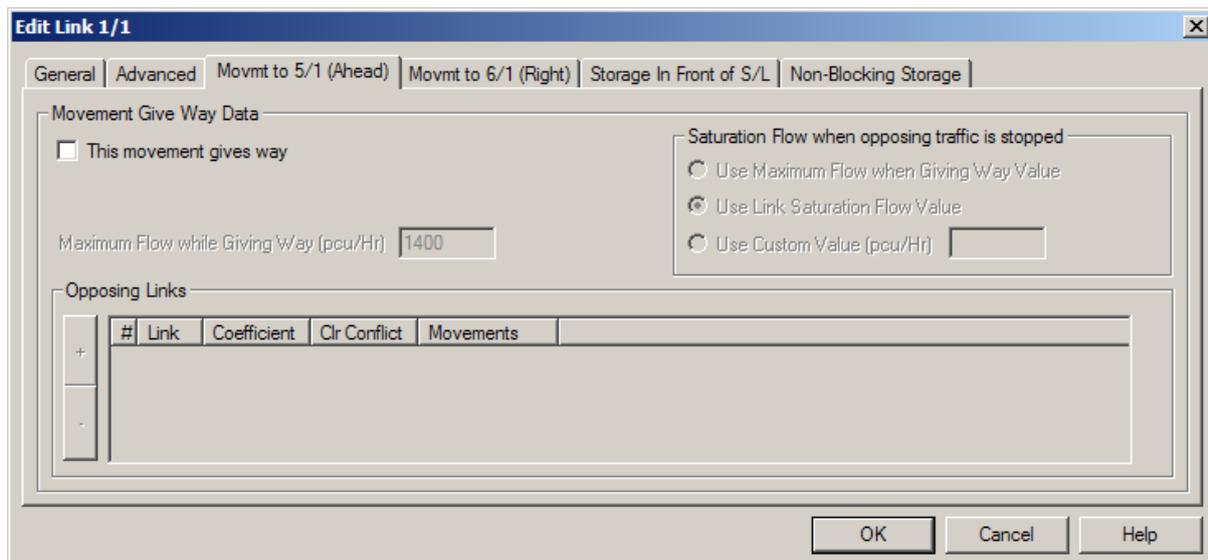


The parameters governing the Right Turn Link are entered using the following tabs of the Link 1/1 Edit Link dialog box.

- Movement tab for Ahead movement to Link 5/1.
- Movement tab for Right Turn movement to Link 6/1.
- Storage in Front of Stop Line tab.
- Non-Blocking Storage tab.

### Ahead Movement Tab

The Ahead Movement tab is simply used to specify that the Ahead movement is non-give-way. This is done by unticking the 'This Movement Gives Way' box.



## Right Turn Movement Tab

The Right Turn Movement tab is used to enter the give-way parameters for the Right Turn in a similar manner to Example 6 above.

**Edit Link 1/1**

General | Advanced | Movmt to 5/1 (Ahead) | **Movmt to 6/1 (Right)** | Storage In Front of S/L | Non-Blocking Storage

**Movement Give Way Data**

This movement gives way

Maximum Flow while Giving Way (pcu/Hr)

**Saturation Flow when opposing traffic is stopped**

Use Maximum Flow when Giving Way Value

Use Link Saturation Flow Value

Use Custom Value (pcu/Hr)

**Opposing Links**

#	Link	Coefficient	Clr Conflict	Movements	Movement 1
0	2/1	1.09	2	<input checked="" type="checkbox"/> All opposing?	<input type="checkbox"/> To 6/1 (Left)
1	2/2	1.09	2	<input checked="" type="checkbox"/> All opposing?	<input type="checkbox"/> To 4/1 (Ahead)

OK Cancel Help

## Storage in Front of Stop Line Tab

Similarly the Storage in Front of Stop Line settings are entered the same as for Example 6.

**Edit Link 1/1**

General | Advanced | Movmt to 5/1 (Ahead) | Movmt to 6/1 (Right) | **Storage In Front of S/L** | Non-Blocking Storage

This is a signal-controlled Right Turn giving way to oncoming traffic.

Does the link have Right-Turn Storage in front of the stopline ?

Right Turn Storage in Front Of Stopline (PCU)

Right Turn Move Up (s)   Auto-Calc Using Storage

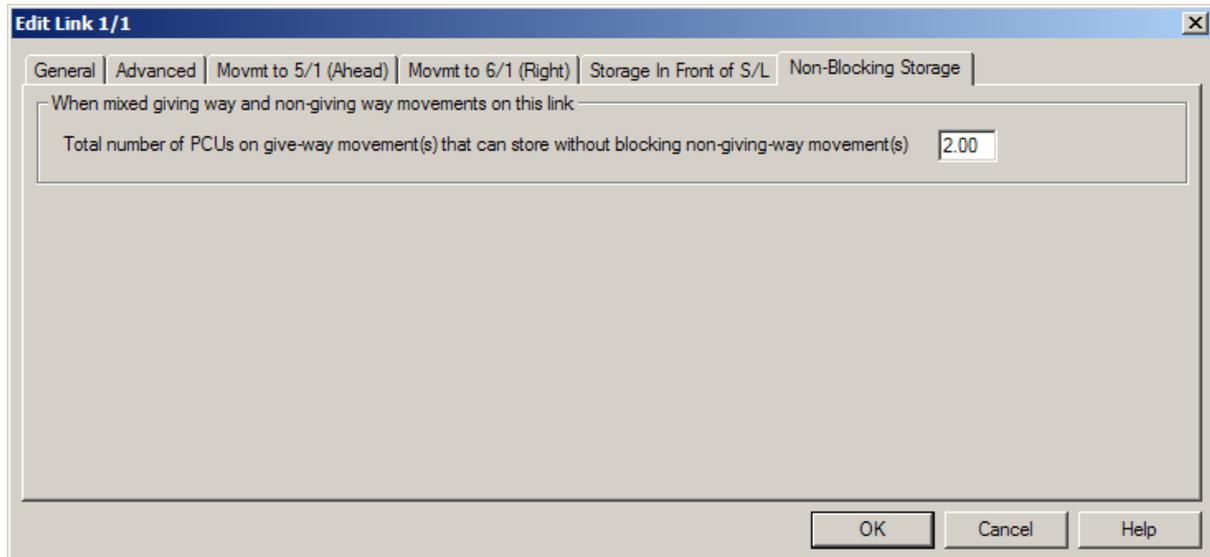
Right Turn Factor

Max Right Turns In Intergreen (PCU)

OK Cancel Help

## Non-Blocking Storage Tab

LinSig automatically models the interaction between the Ahead and Right turn movements sharing a single lane based on the above settings. However as discussed above the Right Turners may block the Ahead movement if they queue back out of the storage area. The 'Non-Blocking Storage' tab is used to specify how many right turning PCUs can accumulate before blocking the Ahead traffic.

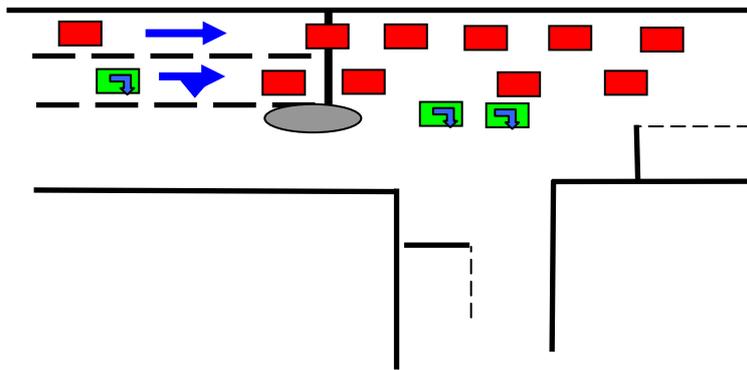


The only setting on the tab is the number of PCU at the front of the storage area which do not block Ahead traffic. In this case as shown above this is 2 PCU with the third Right Turn Storage PCU blocking the Ahead traffic.

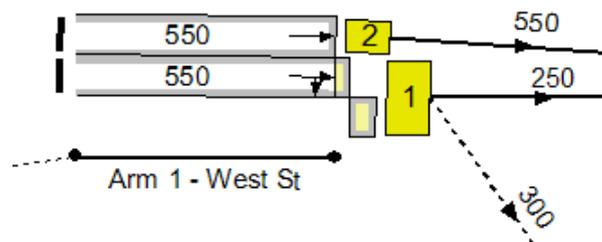
### 7.1.8. Example 8 - Mixed Right Turn Opposed Movements and Ahead Traffic in Multiple Lanes.

Whilst this situation can be modelled by LinSig V2, it may require a small amount of trial and error before a final solution can be achieved. The difficulty is in deciding on how the Ahead traffic will distribute between the Ahead lanes bearing in mind that once the offside lane becomes blocked, ahead traffic will be reluctant to use it.

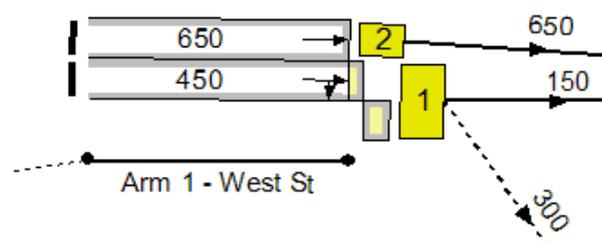
The Link on the offside can be set up as illustrated in Example 7. However, the default automatic traffic assignment will allocate the right turn movement (300) to the link on the offside, and then split the Ahead movement (800) in order to equalise traffic flows in each of the two lanes. LinSig allocates 550 PCU of the Ahead traffic to the left lane and 250 PCU to the right lane resulting in each lane containing 550 PCU. It may however be deemed that as the right turning traffic causes disproportionately higher delay to the Ahead traffic the Ahead traffic will be biased towards using the left lane. In this case the Route List in the Traffic Flow View can be used to manually change the assignment of Ahead Traffic to Routes. This will allow Ahead traffic to be transferred to the left lane in order to achieve equal delay or degree of saturation on each Link as desired.



Mixed Ahead and Right Traffic in Multiple Lanes



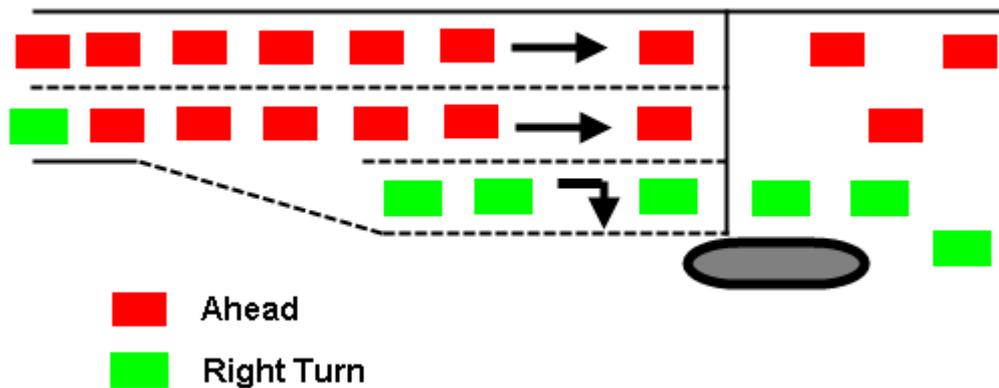
Link Allocation – Auto assigned traffic



Link Allocation assuming only 150 Ahead PCU use offside lane

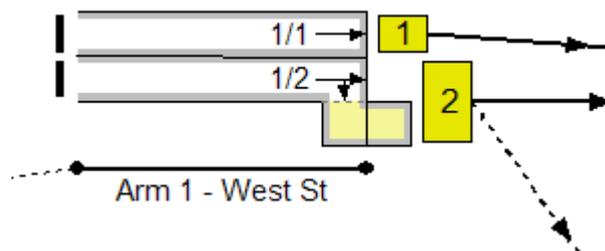
### 7.1.9. Example 9 - Mixed Right Turn Opposed Movements and Ahead Traffic in Multiple Flared Lanes

In this example the right turning traffic has an exclusive right turn lane but this lane is a short lane. This has been difficult to model in many signal design packages for some time including earlier versions of LinSig. LinSig Version 2.4 and above include an improved Right Turn Model which allows the situation show below to be modelled with significantly better accuracy than previously possible.



Mixed Ahead and Right Traffic in Multiple Lanes with flare

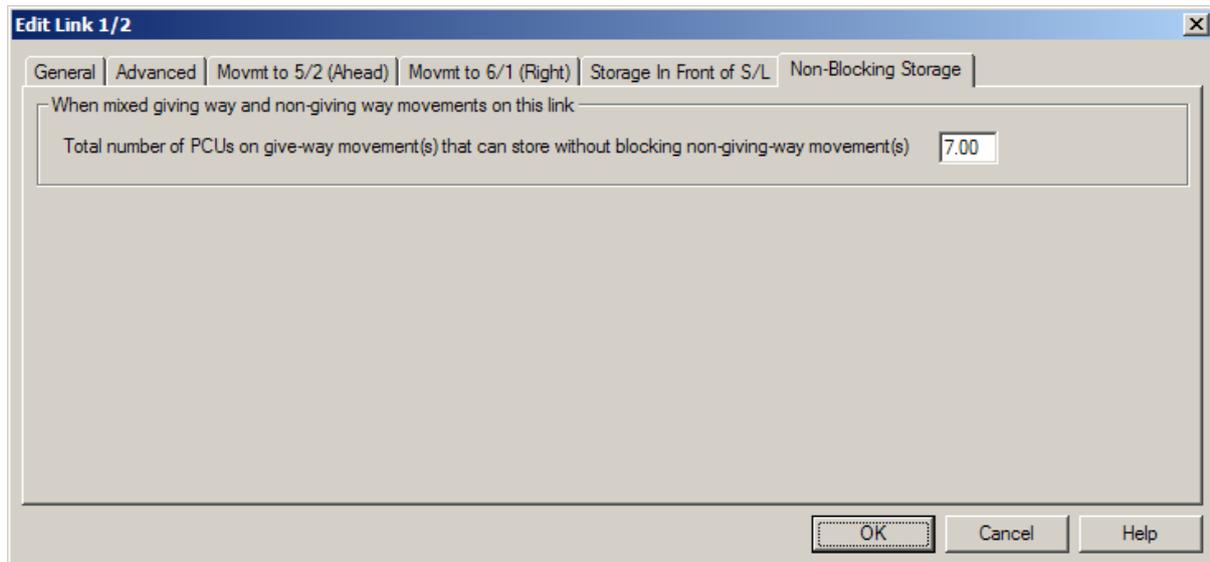
The Link structure used to model the above is:



Some important points to note include:

- The left lane is assumed to be unaffected by the right turn and is therefore modelled as a separate independent Link.
- As the short Right Turn lane affects the middle lane the two lanes are combined together as a single Link. However as the short give-way right turn lane is a special case it is modelled as part of the Link rather than as a separate LinSig Lane. A short Right Turn lane of this type is called a Right Turn Bay in LinSig.

The Right Turn Bay is modelled in a similar way as in Example 7 above. The 'Ahead Movement tab', the 'Right Turn Movement tab' and the 'Storage in Front of Stop Line' tab are all completed as in Example 7. The Non-Blocking Storage tab however is completed as shown below.



The Non-Blocking Storage is entered as 7 PCU to reflect the fact that as well as the 3 PCU in the Storage Area in front of the stop line a further 4 PCU can queue behind the stop line in the Right Turn Bay without blocking Ahead traffic.

# A. Appendix A - Installation and Setup

## A.1. Hardware Requirements

The minimum hardware requirements for LinSig 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, but some tasks such as optimisation may run quite slowly. The suggested hardware specification will significantly increase LinSig's usability and should be adhered to wherever possible.

Minimum Hardware specification

- Pentium PC with at least a 1 GHz processor.
- 128Mb RAM. (This is mainly used by Windows)
- 25Mb 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 for optimum productivity

- Pentium PC with a 2.5-3.0 GHz processor.
- 256Mb RAM. (This is mainly used by Windows)
- 25Mb of free hard disk space.
- Graphics resolution of 1600x1200 with 16.7M colours.
- 19" Monitor – CRT or LCD. (21" desirable if only a single monitor is used)
- An additional monitor (with compatible graphics card(s)) is useful but not essential.
- 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.

## A.2. Software Requirements

LinSig can be used on any of the following platforms:

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

Although LinSig is not formally supported on earlier versions of Windows, it is envisaged that LinSig should run successfully on Microsoft Windows NT Version 4 or Windows 98 with Internet Explorer Version 5.5 or above. LinSig will not run on Windows 95 or earlier.

## A.3. Installing LinSig

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

To install LinSig from CD:

- Insert the LinSig CD into the computers CD Drive.
- If Setup starts automatically, simply follow the on screen prompts from the setup program.

Alternatively if Setup does not run automatically:

- Click on the "Start Button".
- Choose "Run" from the start menu.
- Enter the command "x:setup.exe" where x is the drive letter of your CD drive.
- Follow the on-screen prompts from the setup program.

When Setup is complete, LinSig can be started by choosing "LinSig V2" from the Programs section of the Start Menu.

## A.4. Activating the LinSig Software Licence.

LinSig 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 multiple breaches of licence conditions.

### A.4.1. Definitions

The following definitions are useful in understanding the activation process:

- **Installation ID.** A 30-character code that is unique for an installation of LinSig on a particular PC. The Installation ID is created by LinSig and is based on a number of physical characteristics of the PC.
- **Activation Code.** A 36-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 LinSig's Installation ID has a correctly matching Activation Code will LinSig run.
- **Licence Server.** A separate program that hands out licences to LinSig 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 all or most of the time users wish to use LinSig.
- **Workstation.** The users' computer on which LinSig is run on. Also sometimes referred to as a Client PC.

## A.4.2. Product Activation for Individual PCs

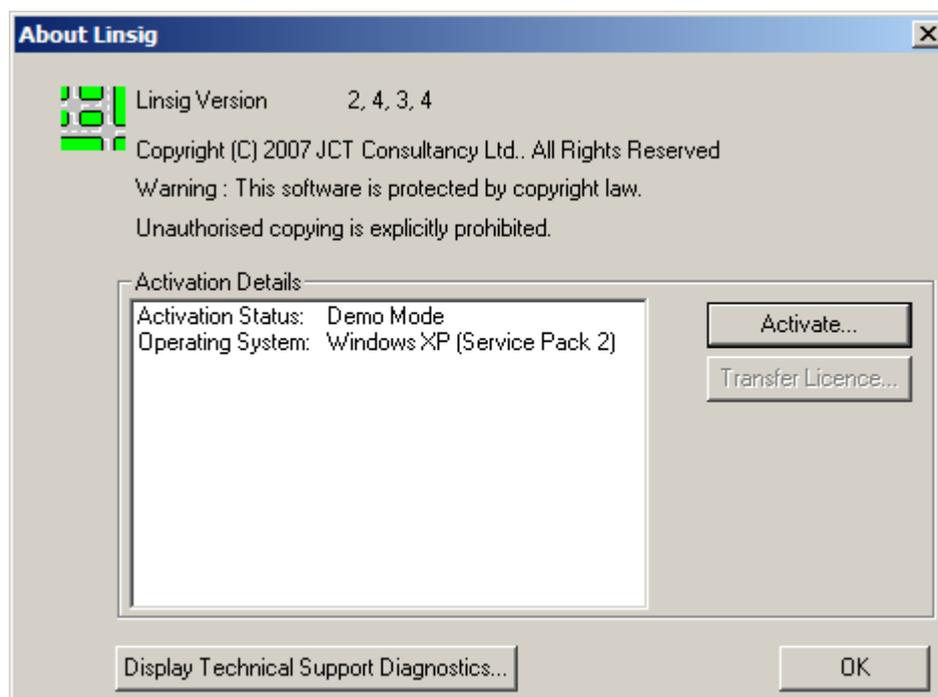
Individual PC activation applies only to Single PC, Four PC and Ten PC site licences and is not available for Unlimited Networked PC Site Licences.

Installing LinSig either from CD or by downloading will install a copy of LinSig 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 within a Site Licence's site using the procedure described later in this section.

### A.4.2.1. Activating the LinSig Licence for the First Time

The activation procedure is as follows:

1. When running LinSig 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 LinSig will run in demonstration mode. It can still be activated later by choosing 'About LinSig...' 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.

**Choose Activation Method**

1 PC, 4 PC or 10 PC licences

In order to activate this product, please enter your licence ID below then click Continue to proceed with the activation process.

Your licence ID will have been supplied to you as part of your software package.

Licence ID :

Office Name :

Computer / User Ref. :

This should be something that can be used to reference this installation later, for example a Computer Name or the User's Name, or just an internal reference number.

Continue...

Network Unlimited Licence

The JCT Consultancy Licence Server should have already been installed on your network by your I.T. administrator. In order to connect to the Licence Server, please enter the I.P. address of the computer on which the Licence Server has been installed.

You can do this automatically by clicking the "Discover Licence Server" button

Once you have the Licence Server I.P. address, click Connect.

Discover Licence Server I.P. Address

Licence Server I.P. Address:

Licence Server Port Number:   Use Default Port Number

Connect...

Activate Later

3. Find your LinSig Site Licence ID. This is the six-character code shown on both the order documentation accompanying LinSig and also on the LinSig CD. An example of its format is LJCT14. 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. LinSig will also request some additional information such as Office Name and Computer/User Reference. Although this information is not essential it is strongly recommended to enter it as it clearly identifies to us which PC the licence has been installed on. We are then able to use this information when your IT department requests a list of installed licences in your organisation when/if software support is renewed. Click Continue when you have entered all the information.

**Choose Activation Method**

1 PC, 4 PC or 10 PC licences

In order to activate this product, please enter your licence ID below then click Continue to proceed with the activation process.

Your licence ID will have been supplied to you as part of your software package.

Licence ID :

Office Name :

Computer / User Ref. :

This should be something that can be used to reference this installation later, for example a Computer Name or the User's Name, or just an internal reference number.

Continue...

4. LinSig will provide you with an Installation ID (displayed in red) that is a customised code for the installation of LinSig 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.

The screenshot shows a dialog box titled "Activate" with a close button (X) in the top right corner. The dialog is divided into two main sections: "Installation details" and "Activation code".

**Installation details:**

- Product: Linsig 2, 4, 3, 4
- Licence ID: LJCT11
- Installation ID: **34ZY28 - PUL52N - Z9U53H - JL36A9 - DQMGJG** (highlighted in red)
- Office Name: Lincoln
- Computer Ref.: PC0034
- Prev. Activation Code: None
- Operating System: Windows XP (Service Pack 2)

Below the details, there is a message: "Please contact JCT to obtain your Activation Code, quoting the details above. For your convenience, you can click the link below to compose an email to request an Activation Code. Alternatively, you can click the Copy button to copy all the installation details to the clipboard ready to be pasted into an email to the email address below:"

The email address is [activation@jctconsultancy.co.uk](mailto:activation@jctconsultancy.co.uk). There is a button labeled "Copy all details to Clipboard".

**Activation code:**

Once you have received your Activation Code, please enter it below, then press Continue.

Alternatively, if you received your Activation Code via email, you can copy the ActivationCode from the email and paste it in by clicking the Paste button below, then press Continue

There is a button labeled "Paste Activation Code from Clipboard".

Below this, there is a label "Activation Code:" followed by six input boxes separated by hyphens: [ ] - [ ] - [ ] - [ ] - [ ] - [ ].

Below the input boxes is a button labeled "Continue...".

At the bottom left of the dialog is a button labeled "Activate Later".

- 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 LinSig and display the relevant licence details, which you should check to ensure they conform to your LinSig licence agreement.



- You will now be able to use LinSig with no restrictions on your PC.
- If your licence allows, further PCs can be activated using the above procedure.

#### **A.4.2.2. Updating the LinSig Licence**

Once activated LinSig 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:

- Choose 'About LinSig...' from the 'Help...' menu within LinSig.
- Click on 'Change Activation'.
- 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.
- LinSig will provide a new Installation ID. This will be different from the Installation ID originally used when activating LinSig for the first time.
- Send the Installation ID to JCT as described above.
- 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'.
- Check the updated licence details displayed are as expected.

#### **A.4.2.3. Deactivating and/or Moving LinSig to a different PC**

The Product Activation system used by LinSig ensures that the software can only be used on the number of PCs actually licensed. If it is necessary to permanently remove LinSig from a PC, the licence can easily be transferred to a new PC or parked with JCT.

**Please note that is essential you deactivate LinSig on the old PC before uninstalling LinSig or disposing of the PC.**

### **Licence Parking**

If you wish to dispose of a PC containing a LinSig licence before a new replacement PC is available it is possible to 'Park' the PC's licence with JCT until needed for the new PC. If you wish to Park any LinSig licences please contact JCT Software Support who will be happy to guide you through the process. You will require access to the PC being deactivated during the call.

### **Transferring a Licence Directly to a new PC**

If you have access to both the old PC and its replacement it is possible to directly transfer the LinSig licence from the old PC to the new PC without needing to contact JCT. To carry out this transfer please follow the procedure below. This will deactivate the licence on the old PC and provide an Activation Code to activate the new PC. **You must have access to both the old and new PCs to carry out this procedure.**

On the new PC:

1. Install LinSig as normal.
2. Follow the instructions in 'Activating LinSig for the first time' up to the point where LinSig 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 PC's 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 LinSig' 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. LinSig 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 LinSig has been closed follow the activation procedure as described above in 'Activating LinSig 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'. LinSig 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. LinSig is now correctly licensed on the new PC.

### **A.4.3. 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 LinSig. 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 LinSig, which may inadvertently migrate away from the licensed site.

#### **A.4.3.1. Installing LinSig on Workstations**

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

#### **A.4.3.2. Installing and Activating the Licence Server**

The Licence Server installation files are located in the 'LicServer' folder on the LinSig 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 LinSig 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 LinSig Licence Server', on the Licence Server PC. This utility allows an administrator to activate the Licence Server for LinSig 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 LinSig users.

#### **A.4.3.3. 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 to pre-configure the licence mode and Licence Server location in each Workstation's registry.

#### **Manual Configuration of Workstations**

1. When running LinSig 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 LinSig will run in demonstration mode. It can still be activated later by choosing 'About LinSig...' 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'. LinSig will search the local network for a LinSig 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 LinSig Licence Server.

4. Click 'Connect' to attempt to connect to the LinSig Licence Server. If the connection is successful, LinSig 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.

#### **A.4.3.4. Technical Note for IT Administrators**

Please note that the Licence Server must be visible to the client PC over the network 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 LinSig Licence forbids the forwarding of broadcasts from the Licence Server to segments of a network geographically located outside of the LinSig Site.

## **A.5. Obtaining and Installing Updates to LinSig**

Users with current software support have free access to LinSig updates via the software support section of our web site [www.jctconsultancy.co.uk](http://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](http://www.jctconsultancy.co.uk) where full instructions are provided for downloading and installing LinSig updates.

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

#### **A.5.1.1. Automatic Update Notification**

If desired LinSig 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 LinSig installs with automatic update notification switched off, and asks whether you would like to enable this when LinSig is run for the first time. Updates can easily be switched on at any time using the 'Program Settings and Defaults' dialog box accessed from the LinSig 'File' menu. LinSig transmits no personal information to JCT Consultancy when checking for updates.

#### **Automatic Update 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 LinSig to work with your firewall.