IPAG

Irish Pavement Asset Group

Pavement Asset Management Guidance Section 2: Network Referencing

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An Roinn Iompair Turasóireachta agus Spóirt
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LGMA
AN GHNÍOMHAIREACHT BAINISTÍOCHTA ÁITIÚIL
LOCAL GOVERNMENT MANAGEMENT AGENCY

Document Information

Title	Pavement Asset Management Guidance, Section 2: Network Referencing
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Description	This section provides a recommended method of network referencing for use in Ireland. It sets out how a network of roads should be referenced, to enable data to be stored against the network.

Document History

Version	Status	Author	Checked	Changes from Previous Version
1.0	Published	PH / GK	CM / MMcN	

2 Network Referencing

2.1. Introduction

This section provides a recommended method of network referencing for use in Ireland. It sets out how a network of roads should be referenced, to enable data to be stored against the network. It is based upon methods used internationally, but has been specifically created to take into account Ireland's road network.

Network referencing is an essential component of any road asset management system / approach. Network referencing is the method used to assign a unique address to each location on the road network. The use of an easy to follow and logical method of network referencing enables road authorities to organise the collection and management of their asset data in an efficient manner.

The adoption of a national standard will create cost efficiencies in relation to the development and implementation of road asset management systems and for data collection. It can also provide a consistent basis for the reporting of inventory, condition and other asset data at a national level.

At a local level the use of network referencing will provide benefits in terms of:

- Reducing the time spent by field staff locating assets on site;
- Enabling works crews to be sure that they are completing the right work;
- Customer confidence that council representatives arrive at the correct location.

The network referencing method detailed in this document includes:

- Identifying road segments and sub-segments;
- Cross-sectional positioning options;
- Modifying and maintaining the network.

This document does not deal directly with how point item assets are located. Data collected using coordinates, for example using GPS or map-based data logging, can be located against the relevant network link using buffering technology. It can be added to the network using an automated process in the office after field data collection.

2.2 Linear Referencing

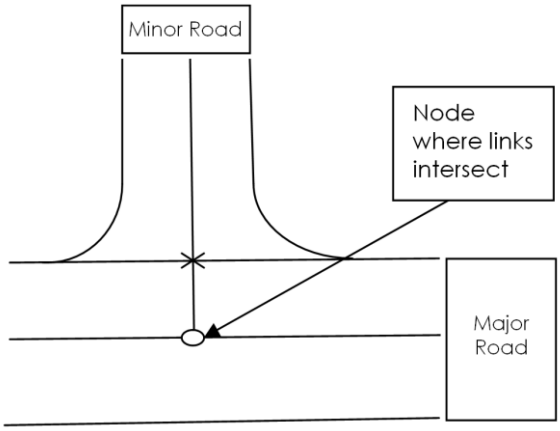
Linear referencing is a system in which the pavement assets are identified by a relative measure along a linear element. The system is designed so that if a segment of a route is changed only those assets on the changed segment need to be updated.

Any feature for which data is recorded can be located by its position in relation to the start of its segment. Creating a base network of interconnected segments, as required by this guidance, means that all data that is collected can be referenced to a common location reference, i.e. its nearest road segment. It is important that all data is referenced to a common location reference, if different data sets are to be analysed together.

2.3 Start and Finish Definition

A link and node network links the centre-line of any side road with the centre-line of the major road that it intersects. This ensures that the network is connected and makes sense when presented graphically. It is clear which roads intersect with each other. There are no gaps. However, it creates centre-line lengths that overstate the actual total road length. As shown in *Diagram 2.1*, this results in the length of the minor road being overstated in the system by half the width of the major road. The most common location for these points is the centre-line of the intersecting roads or the end of the road itself.

Diagram 2.1



2.4. Overall Network Layout

The primary document for defining a network layout is the *Guidelines for Classification and Scheduling of Roads in Ireland (Department of Transport, Tourism and Sport)*. The methodology set out in that document had evolved over a good number of years, with most of the road network scheduled on this basis and in the Local Government Management Agency's (LGMA) MapRoad system.

2.5. Linear Referencing Development Process

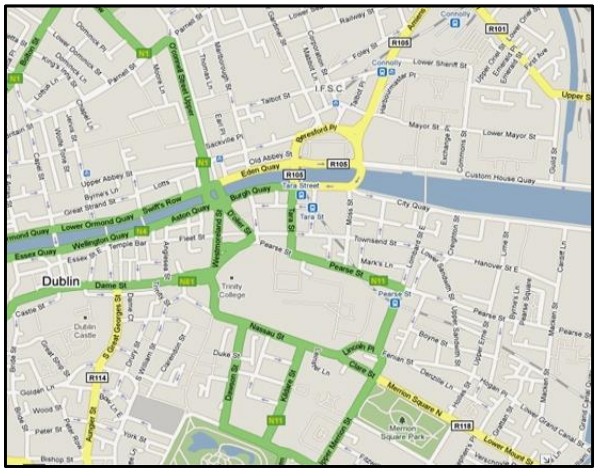
The following steps are recommended to be used to establish a base network of roads.

Step 1: Identify Public Road Network

Using a map of an area and local authority records, identify and number all public roads in accordance with the road schedule guidelines, which provides a methodology to number roads. Each road must have an exact definition of the 'start' and 'end' node. The most common location for these points is the centre-line of the intersecting roads or the end of the road itself.

Figure 2.1

Map of a Rural Road Network



Map of an Urban Road Network

A dual carriageway is a road in which the two directions of traffic are separated by a central barrier. Although the road schedule requires a single line for each road, for the purposes of more detailed referencing each side of the central barrier is treated as an individual road segment, with one side being a 'Dummy Segment'. The length of the road section should always be recorded. If this is not already known then it should be measured using calibrated equipment.

Step 2: Identify Segments

Roads are divided into individual segments or lengths. Normally segments should go from junction to junction and should not exceed 1 kilometre in length. Segments should be numbered sequentially, from one end of a road to the other. Segment numbers should be unique for each road, including where a road spans a county or administrative boundary. A node should always be located at the boundary. Where a road spans an administrative boundary, either the sequencing or use of blocks of numbers need to be considered or agreed between road authorities.

A segment has a start node and an end node. The roads schedule provides information that shall be used for allocating nodes. The segments are continuous lengths of road between adjacent junctions, from junction to street end or between other defined criteria.

Other options for segment start and end nodes can include the following:

- Changes from single to dual carriageway.
    - Start / end change point located at the boundary on the centre-line of the single roadway.
- Changes of road classification.
    - Start / end change point located at the boundary on the centre-line.
- Links and slip roads (e.g. at complex junctions).
    - Start / end point located where the link or slip road starts / ends.
- Links in a roundabout (Note: a roundabout should only be a separate segment if it has an inscribed circle diameter greater than 20 metres).
    - Start / end point at the edge of the roundabout traffic island closest to the single / dual carriageway.

On long, rural road segments, where none of the options above exist, additional features including streams, bridges, bends or boundary markers can be used as a start or finish of a segment. It is important that the exact location of the start / end node can be located. If bends or streams are used, it can be helpful if additional signage is included as a method of marking the location. If bridges are to be used, it is recommended that the location point is at the first abutment.

2.6 Cross-sectional Positioning

Cross-sectional positioning allows individual assets to be uniquely identified, placed and offset along a road segment and thus linked to a road database. The use of cross-sectional positioning should only be used where required, such as for urban roads or main roads where there would be a need for such data driven by a large amount of work or maintenance activity.

For much of the road network, such as minor rural roads, cross-sectional positioning would not be needed, with a single road schedule centre-line being sufficient.

Many road assets are not located on the roadway. Assets such as footways, kerbs, and other associated items are normally located in the area between the road boundaries. Where used, the network referencing method therefore needs to describe the transverse position, to enable the identification of the accurate location of assets such as drainage apparatus that cannot be easily located from a longitudinal reference alone.

It is recommended that the total road cross section* is divided into:

i. Roadway – area of road where a vehicle can legally be driven.
ii. Off-roadway – all non-roadway sections of the road area.

** For the purposes of this guidance the edge of the road cross section is the road boundary.*

Figure 2.2: Basic Structure of a Road Cross-section

Road Boundary	Off-roadway		Roadway					Off-roadway		Road Boundary
BLh	OLh_1	FLh_1	RLh_2	RLh_1	RCl (Centre-line)	RRh_1	RRh_2	FRh_1	ORh_1	BRh

2.6.1 Cross-sectional Position Definitions: Minimal (Simple) Method

Where a road authority decides that a simple approach to network referencing is appropriate, the method below is recommended. There are three cross-sectional positions for roads using the Minimal (Simple) Method. See *Figure 2.3*.

R — For assets and defects located on, above or below the roadway, defined as the surface for travelling motor vehicles.

Lh — For assets and defects located to the left-hand side of the centre-line.

Rh — For assets and defects located to the right-hand side of the centre-line.

In the case where there are more than two features, RLh_1 will be allocated to the feature closest to the road centre-line.

Figure 2.3: 'Minimal' Method Cross-sectional Positions

Road Boundary	Off-roadway	Roadway	Off-roadway	Road Boundary
Lh		R	Rh	

2.6.2 Cross-sectional Position Definitions: Full Method

Where a road authority decides that its network and needs warrant using network referencing at a more detailed level, the method below (or elements of it) can be used.

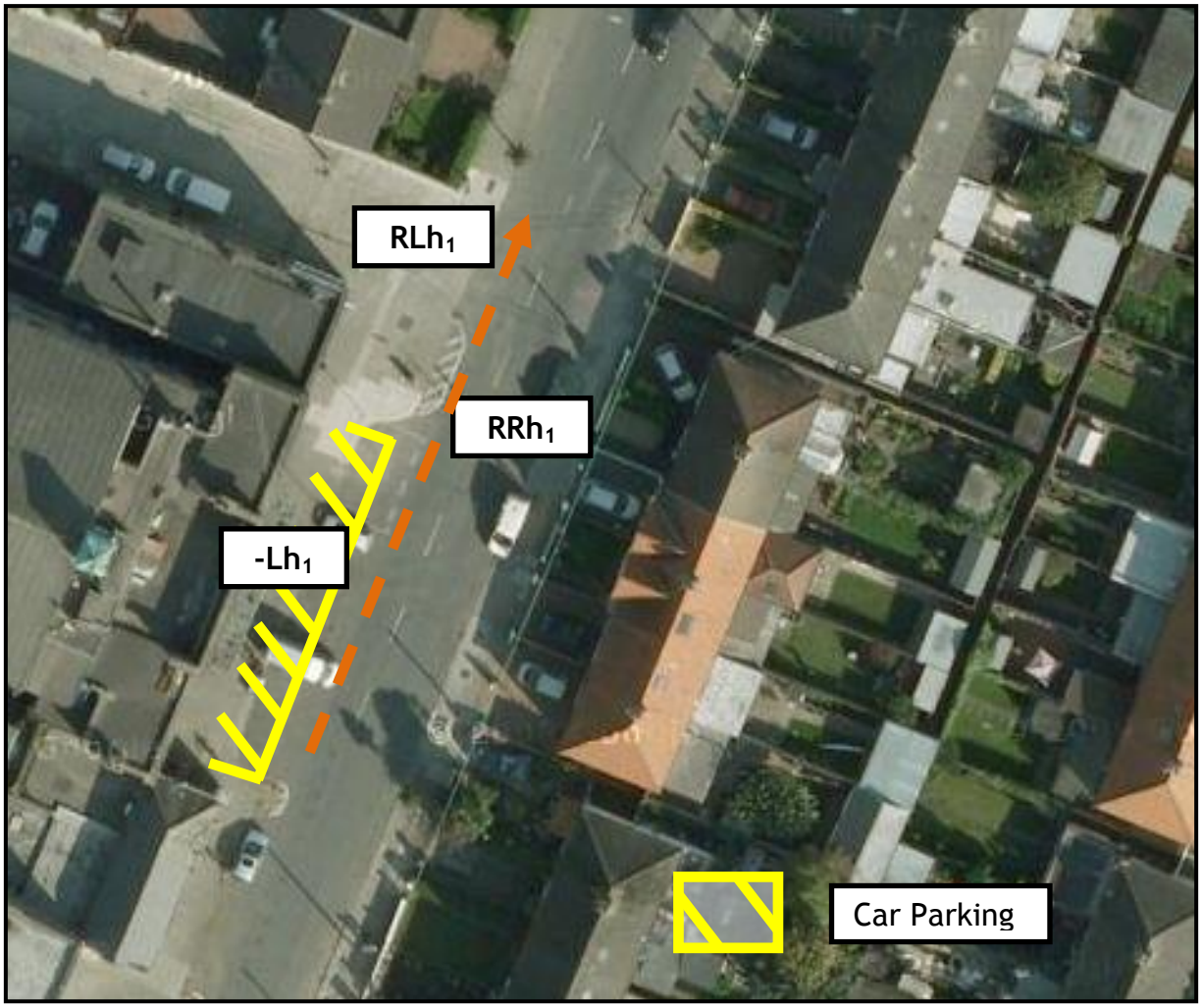
Figure 2.4: Cross-sectional Position Definitions: Full Method

	Road Boundary	**Off-roadway**		**Roadway**										**Off-roadway**		**Road Boundary**
Label	BLh	OLh_n		HLh	$-Lh_n$		RLh_n		$+Lh_n$		RCl	$+Rh_n$		RRh_n		$-Rh_n$		HRh	ORh_n		BRh
		OLh_2	OLh_1		$-Lh_2$	$-Lh_1$	RLh_2	RLh_1	$+Lh_2$	$+Lh_1$		$+Rh_1$	$+Rh_2$	RRh_1	RRh_2	$-Rh_1$	$-Rh_2$		ORh_1	ORh_2	
Label Name / Options		• Kerb • Footway (Flexible) • Footway (Modular paving) • Cycle track (Flexible) • Verge (Grass) • Verge (Concrete)		Left Hard Shoulder	Left Additional Nearside Lane • Dedicated Bus Bays / Lanes • Parking Bays • Acceleration Lanes • Lay-bys • Intersection Priority Lanes		Permanent Left Lane		Left Additional Offside Lane • Dedicated Bus Bays / Lanes • Acceleration Lanes • Parking Bays • Lay-bys • Intersection Priority Lanes		Centre-line	Right Additional Offside Lane • Dedicated Bus Bays / Lanes • Acceleration Lanes • Parking Bays • Lay-bys • Intersection Priority Lanes		Permanent Right Lane		Right Additional Nearside Lane • Dedicated Bus Bays / Lanes • Parking Bays • Acceleration Lanes • Lay-bys • Intersection Priority Lanes		Right Hard Shoulder	• Kerb • Footway (Flexible) • Footway (Modular paving) • Cycle track (Flexible) • Verge (Grass) • Verge (Concrete)		
Definition	Legal limit (boundary) of the road.	Areas within the road boundary that aren't classified as roadway. The area is divided into features based on usage and material. Features are labelled OLh_n (where n = feature number).		Area of hard pavement between lane edge line and edge of roadway – maximum of one HLh per road cross-section.	Lane which normally does not carry 'through traffic' or which runs for only a short distance. Each lane type is labelled $-Lh_n$ (where n = additional lane number).		Lane for 'through traffic'. Lanes are labelled RLh_n (where n = lane number).		Lane which normally does not carry 'through traffic' or which runs for only a short distance. Each lane type is labelled $+Lh_n$ (where n = additional lane number).		A point or area between opposing directions of traffic flow – only one RCl for each road cross-section.	Lane which normally does not carry 'through traffic' or which runs for only a short distance. Each lane type is labelled $+Rh_n$ (where n = additional lane number).		Lane for 'through traffic'. Lanes are labelled RRh_n (where n = lane number).		Lane which normally does not carry 'through traffic' or which runs for only a short distance. Each lane type is labelled $-Rh_n$ (where n = additional lane number).		Area of hard pavement between lane edge line and edge of roadway – maximum of one HRh per road cross-section.	Areas within the road boundary that aren't classified as roadway. The area is divided into features based on usage and material. Features are labelled ORh_n (where n = feature number).		Legal limit (boundary) of the road.

Cross-sectional Position Examples

Example 2.1

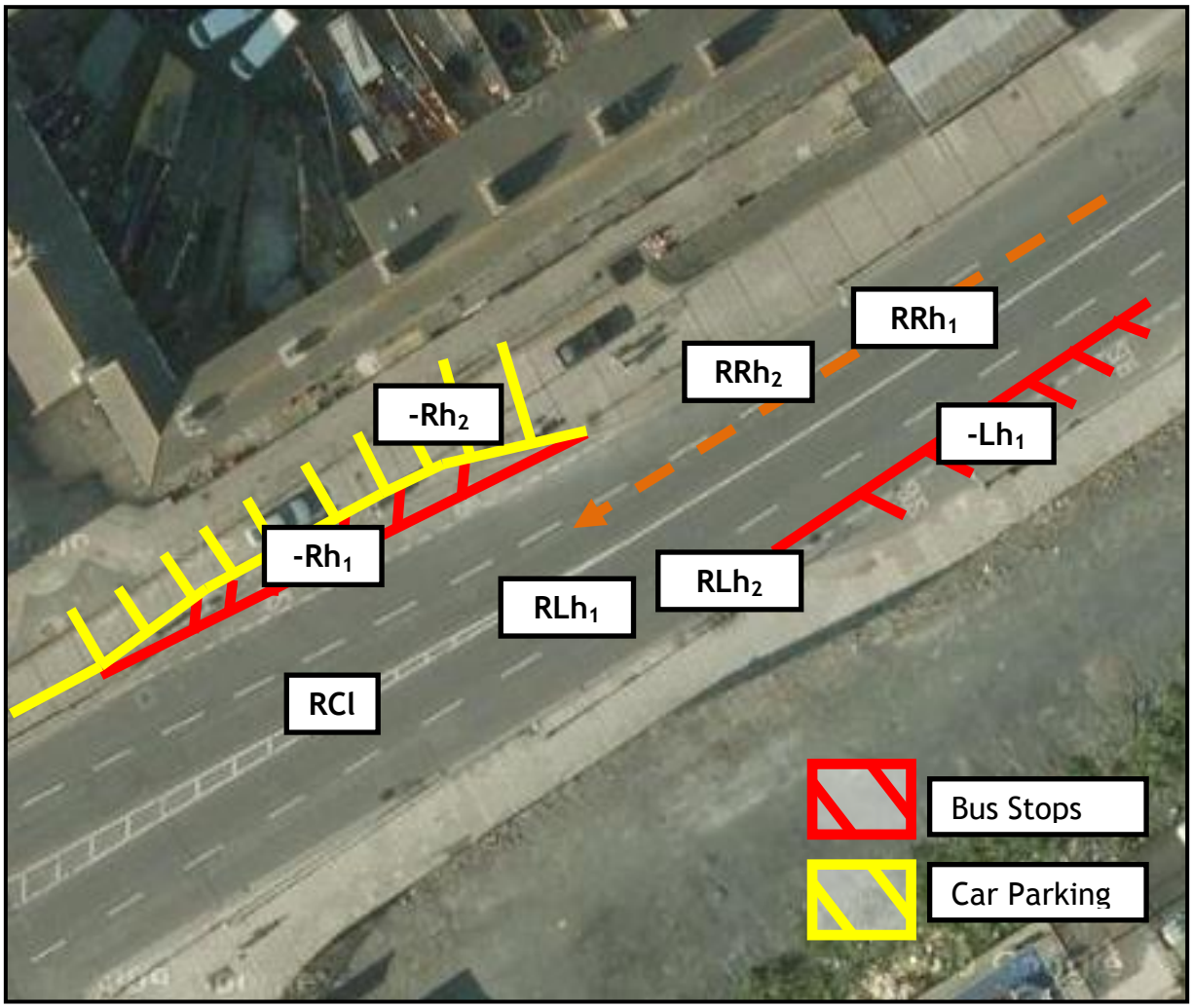
A residential two-lane, two-direction road (one lane per direction) with parking bays on the left-hand side (-Lh_1). The orange dashed line represents the direction of increasing chainage, as per the base network.



Background image: Google Maps

Example 2.2

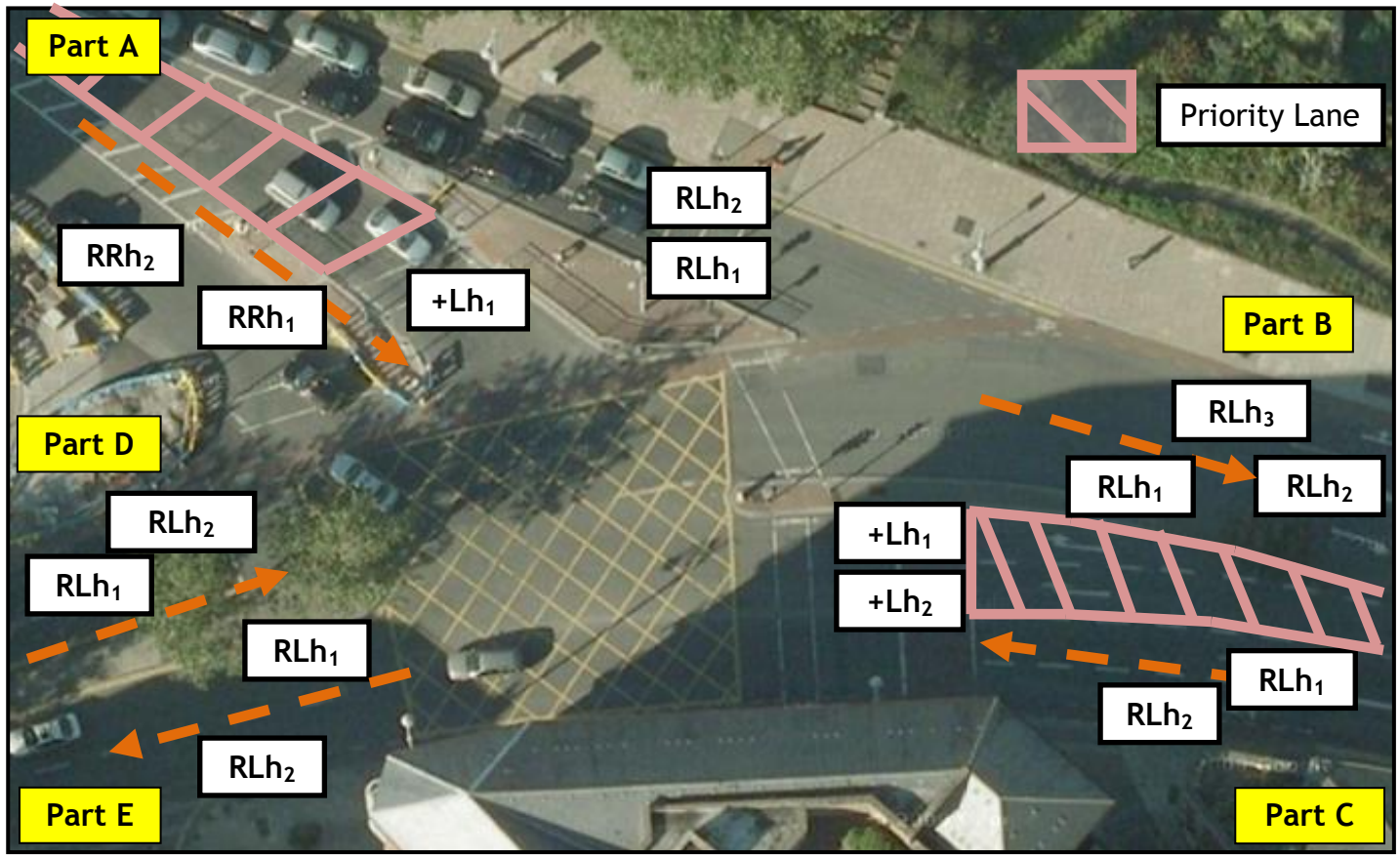
A four-lane, two-direction road with bus stops on both sides (-Rh_1 and -Lh_1) and parking on the right-hand side (-Rh_2).



Background image: Google Maps

Example 2.3

A more complex example of a multi-lane intersection which is divided into five parts:



Part	Road Description
A	Four-lane, two-direction roadway.
B	Dual carriageway
C	Dual carriageway with additional right-turn priority lanes.
D	Dual carriageway
E	Dual carriageway

Background image: Google Maps

2.6.3 Off-roadway

In this process, the areas within the road boundary, that aren't classified as roadway, are called 'off-roadway'. Examples include kerb, footway, cycleway and verge. Features are labelled OLh_n or ORh_n (where n = feature number). In the case where there are more than two features, OLh_1 will be allocated to the feature closest to the road centre-line.

Figure 2.5: Example of Off-roadway Pedestrian / Cycle Track on Left Side of Road

Off-roadway						Roadway
OLh_6	**OLh_5**	**OLh_4**	**OLh_3**	**OLh_2**	**OLh_1**	**RLh_1**
Left Footway (2) (Modular paving)	Left Outer Verge (Concrete)	Left Footway (1) (Flexible)	Left Cycle Track (Flexible)	Left Inner Verge (Grass)	Left Kerb	Left Roadway

Figure 2.6: Road Boundaries

Road Boundary	Off-roadway		Roadway					Off-roadway		Road Boundary
BLh	OLh_2	OLh_1	RLh_2	RLh_1	RCl (Centre-line)	RRh_1	RRh_2	ORh_1	ORh_2	BRh

The road boundary is the legal limit of the road. The road boundaries are denoted 'BLh' and 'BRh' for the full cross-sectional position method.

2.7 Segment and Cross-section Definitions

The following is the methodology, by which identifiers are assigned to road segments.

AAAA These characters shall consist of Local Authority (Road Authority) code.

BB The next characters represent the road class. Permitted codes include: NP, NS, R, LP, LS and LT.

CCCCC The next five digits indicate the road number, such as 45634 for the L45634.

DDD The last three digits represent the segment number.

EE Indicates the direction of travel, as defined when the road is digitised. The codes used therefore are 'D1' or 'D2'.

FF Represents element type. The following element types are allowed as part of the network definition, ***MI*** (mainline), ***CI*** (Centre-line), ***Rb*** (Roundabout), **L_1** through to **L_9** (link road), **F_1** through to **F_9** (free-flow) and **E_1** through to **E_9** (exit / entry ramps). Note that these codes are not to be confused with those used for lane type.

GG Lane Type: **RLh** (Roadway), **HLh** (Left Shoulder, etc.).

H Indicates lane number, values **1 through to 9** allowed.

JJJ Used to denote the sample unit number. Sample units are 100 metre divisions of network segments and sample unit identities are unique per segment. Values 001 through to 999 are allowed.

2.8 Adding or Modifying Roads

It is essential that the network (database) is maintained and is updated when changes occur. These changes will include the addition of new road segments or sub-segments, the modification of existing road segments or sub-segments and the removal of road segments or sub-segments.

Table 2.1 provides a list of situations where the network will need to be reviewed. *Form 1* must be completed whenever a review is required.

Table 2.1: List of Situations Where a Network Might be Reviewed

Modification	Review required		Comments
	Road Segment	Cross-sectional Positions	
Addition of extra roadway or bus lane	Yes	Yes	New road segment / sub-segment required when more than 50 metres of additional roadway is constructed.
Addition of designated turning bay	Yes	Yes	• If created within current roadway only cross-sectional positions need to be assessed. • If new roadway constructed then new road segment or sub-segment to be created.
Realignment reducing current length	Yes	Yes	Cross-sectional position modifications won't be necessary if off-roadway features aren't changed.
Addition of new footway / cycle track		Yes	If the roadway remains the same only the addition of the cross-sectional position of the new footway / cycle track is required.
Addition of new roads	Yes	Yes	
Removal of existing roads			'Stopping-up' process to be completed.

It is recommended that an individual (the Information Manager) is allocated responsibility for ensuring that the network is kept up to date. It is the responsibility of the Information Manager to identify when changes occur and review is needed. An example form that may be used for recording and notifying changes to the network is included below (*Form 1*). It is recommended that the Information Manager sign all completed '*Form 1*' to confirm that the asset database remains accurate to a specified level of accuracy.

Form 1 – Network Modification Form		**Diagram of Road Layout**
Road Name:	**Date:**	
Road Number:	**Name:**	
Road Segment:	**Signature:**	
Reason for Modification:		

Longitudinal Referencing

Start Point Description:		**End Point Description:**
Length	**New:**	**Old:**

Cross-sectional Positioning

Roadway	**HLh**	**-Lh**	**RLh**	**+Lh**	**RCl**	**+Rh**	**RRh**	**-Rh**	**HRh**
Number of each roadway type									
Description (e.g. -Lh_1 = bus lane)									
Off-roadway	**Lh_4**	**Lh_3**	**Lh_2**	**Lh_1**		**Rh_1**	**Rh_2**	**Rh_3**	**Rh_4**
Define feature (e.g. Lh_1 or kerb)									

Data Entered into System	**Name:**	**Signature:**	**Date:**
Information Manager	**Name:**	**Signature:**	**Date:**