Chapter 1

Safe, Reliable and Efficient Freeway Operation

1.1. Managed Freeways – Introduction

Melbourne's freeway and tollway network[1] carries 30% of the arterial road traffic although comprising only 7% of the arterial road network length. The efficient use of freeways and tollways is essential in providing a safe and reliable level of service that maximises the productivity of the asset and provides optimum operation in relation to throughput and travel time.

An actively managed freeway may incorporate a number of traffic management tools which provide a range of benefits. The most effective traffic management tool for managing freeway flow to achieve high levels of efficiency and reliability is access control with coordinated freeway ramp signals.

1.2. Freeway Ramp Signals – An Overview

Freeway ramp signals are traffic lights installed on an entry ramp to meter traffic into the freeway in a measured and regulated manner in order to manage the freeway traffic flow and prevent congestion. Flow breakdown and congestion reduce throughput, increase travel time and represent under-utilisation and lost productivity of a high value facility.

An actively managed coordinated system of ramp signals based on contemporary traffic flow theory can provide stable and reliable travel by optimising throughput and travel speed on the freeway as well as preventing, or delaying, the onset of traffic flow breakdown and congestion.

VicRoads use of the HERO suite of algorithms provides coordinated dynamic management of Melbourne's freeways. This provides proven results in achieving the objectives of managed freeways.

Figure 1.1: Freeway Ramp Signals

Local ramp metering controls the entry of traffic at a ramp based on local freeway bottleneck conditions as well as ramp data. This is isolated operation that is independent of what is happening at other entry ramps.

Coordinated freeway ramp signals use a dynamic algorithm that makes a combined decision based on data from the freeway and a number of entry ramps. This operation is able to regulate the entry of traffic from a number of ramps to address the overall freeway objectives and to balance flows between ramps.

General information relating to freeway ramp signals is provided in an information bulletin in Appendix A.

1 Includes the actual and estimated 2008 median midweek non-holiday 24 hour volume for the Inner and Outer Metropolitan Statistical Division as defined by Australian Bureau of Statistics.

The US Federal Highway Administration has issued a ramp metering information brochure (2006) which includes the following comment summarising the success of ramp metering:

No other traffic management strategy has shown the consistently high level of benefits in such a wide range of deployments from all parts of the country.

Pete Briglia,
Puget Sound Regional Council, Seattle, Washington and Chair of the TRB Freeway Operations Committee.

1.3. Context within an Integrated System

Managed freeways with coordinated freeway ramp signals operate within the VicRoads road network management framework as shown in Figure 1.2.

Further information relating to the integration of freeway ramp signals within a managed freeway environment is provided in Section 3.1. Information relating to the arterial road interface is in Chapter 8.

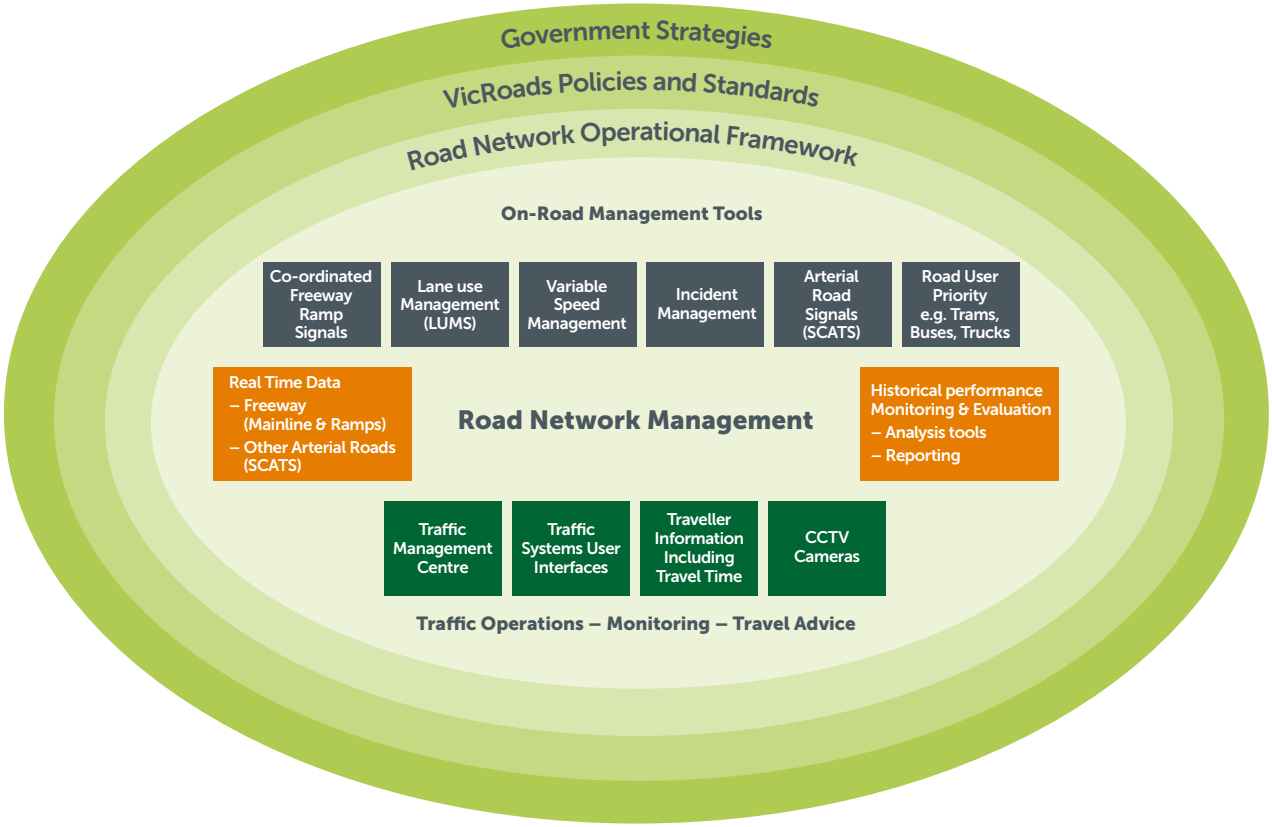

Figure 1.2: VicRoads Road Network Management

1.4. Background

In 2002 VicRoads commenced the installation of ramp metering at freeway interchanges to reduce traffic flow congestion on the freeway and to improve merging. The entry ramp metering at each site operated in an isolated manner with a fixed time cycle to manage the rate at which vehicles could join the freeway.

In 2008 the trial of dynamic coordinated ramp metering signals resulted in increased freeway performance and greater reduction of flow breakdown. This was based on the effective management of inflows over a length of freeway to match the capacity of the mainline at each merge as well as the critical bottlenecks.

A short history of ramp metering in Melbourne and internationally is in Appendix B.

1.5. This Handbook

This Handbook provides the rationale, criteria and design principles for providing freeway ramp signals. The Handbook structure includes:

Chapter	Contents
1	Introduction, background and context of managed freeways and freeway ramp signals.
2	Principles of freeway traffic flow including background relating to fundamental and contemporary traffic flow relationships and traffic flow breakdown leading to congestion.
3	Principles of ramp metering including the principal aims and benefits, managing the arterial road interface and the principles of operation to control access and prevent flow breakdown.
4	Criteria for providing freeway ramp signals on existing and new freeways or ramps.
5	Importance of reliable freeway traffic data and analysis.
6	Guidelines for capacity analysis and design, including typical layouts for freeway ramp signals.
7	Operation of ramp signals including an outline of the algorithms used by VicRoads and traffic management relating to emerging congestion and other tools in a managed freeway.
8	Managing the arterial road interface – entry ramps and exit ramps.
Appendices	
A	Freeway Ramp Signals - Information Bulletin.
B	Short history of ramp metering.
C	Photometric test results of LED lanterns.
D	Congestion management using ramp signals and traveller information signs.
E	Glossary of terms and traffic flow relationships.
F	References.