

# Case Study Project: Ramp Metering Design Analysis

Client: Main Roads Western Australia

## Overview

The metering of freeway ramps is becoming a more common solution to better ration scarce freeway capacity and to optimise mainline flow.

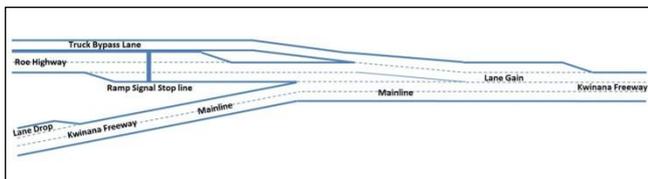
Main Roads Western Australia are currently investigating the application of ramp metering as part of a Managed Freeway approach to improving freeway conditions.

## The Study

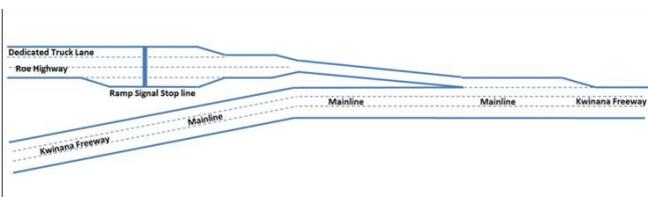
Urbsol were engaged to analyse the operational performance difference of two design alternatives for the Kwinana Freeway / Roe Highway interchange.

- Option 1 considers ramp metering operating with the on-ramp design as shown in the first figure below. The truck bypass lane is not controlled by ramp signals and merges with the added lane further downstream.
- Option 2 considers ramp metering with the on-ramp design as shown in the second figure. The design facilitates simultaneous release of 4 vehicles per green time. Following the clearance of the stop line vehicles merge from 4 lanes down to 2 lanes and then to 1 lane.

Simulation based analysis was required to better understand the implications of ramp metering for the two options as part of the performance comparison.

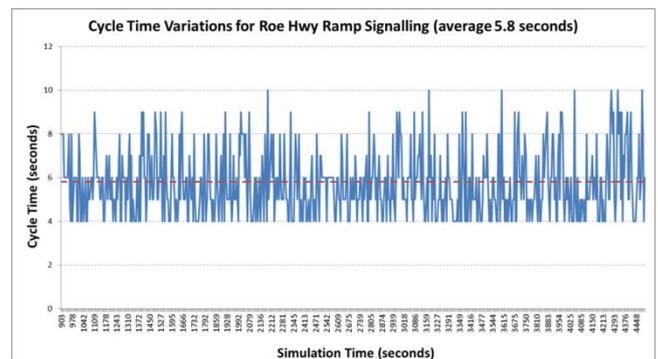


Option 1 ramp metering schematic diagram (not to scale)



Option 2 ramp metering schematic diagram (not to scale)

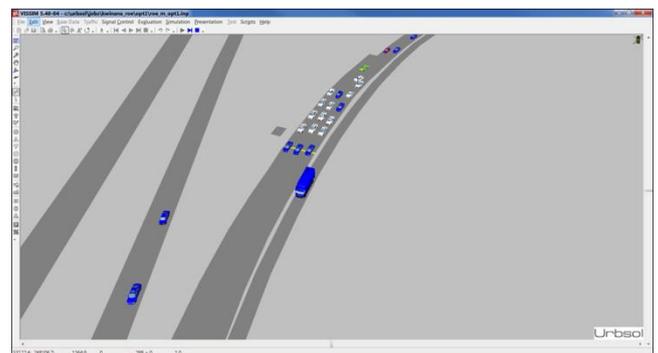
The ramp metering signal logic was developed in VISSIM Vehicle Actuated Programming (VAP) to approximate the operation of real ramp signals by using vehicle occupancy rates from mainline detector loops. Depending on the mainline density the signal logic would vary the length of red time therefore changing the operating cycle time and ramp capacity. The simulation analysis was also used for the evaluation of diverging, merging and weaving areas which required careful adjustment of driver behaviour parameters in VISSIM.



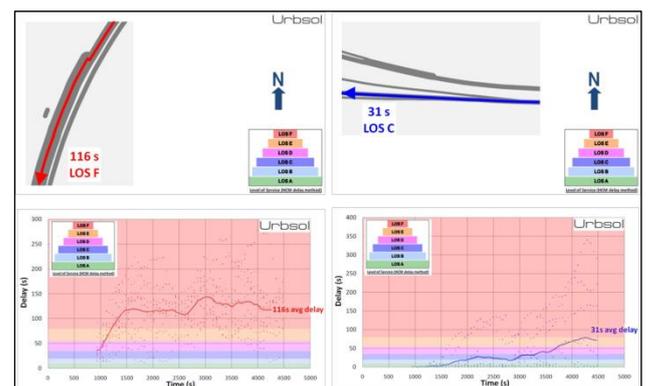
Monitoring of cycle time variations during simulation

## Simulation

Urbsol used VISSIM microsimulation software to assess the likely performance differences between the alternatives. It was found that design option 1 performed better and was more resilient to future demand increases.



VISSIM Simulation of ramp metering in Option 1



Delay and LoS monitoring during simulation

VISSIM was chosen as the most suitable tool for this work for a number of reasons:

- Flexibility in applying metering signal logic using detector loop occupancy rates
- Realistic vehicle kinematics for modelling merging and weaving behaviour
- Dynamic measurement of delays queues and LoS