

Chapter 8

Arterial Road Access Management



8.1. General Principles

Section 3.3 outlines the principles associated with the integration of managed freeways with the arterial road network to achieve an effective freeway / arterial road interface. The objective indicates that, when necessary, the freeway network is to be given priority over the arterial road network and, where this would result in a negative impact on the arterial network, this should be managed accordingly to provide a net overall gain to the system's users. This implies that entry and exit ramp flows need to be given priority over the arterial road.

8.2. Managing Entry Ramp Queue Overflows

8.2.1. Potential Ramp Problems

In managing freeway access, the principal consideration is preventing flow breakdown on the freeway and optimising efficiency (travel time and throughput). Therefore, the freeway capacity is the main factor determining the ramp entry flows, rather than the traffic demands on the ramps themselves. Whilst this philosophy generally transfers operational delays from the freeway carriageway to the entry ramps, the delays for the arterial road network as a whole, including freeways, are reduced relative to operating a congested freeway.

Ideally, ramps should be designed to accommodate queues as described in Section 6.3.4. The ramp queues should then be managed within the ramp length. However, at locations where assessment indicates that high entry ramp demands cannot be satisfied, i.e., it may not always be feasible to extend ramp storage, the traffic queues may extend onto the arterial road network. In other cases it may be more economical to provide for storage on the arterial road rather than extend the freeway ramp. In this situation the additional storage should be provided to avoid interference with arterial road flows.

During real time operation, the queue override module in the HERO suite of algorithms enables the ramp entrance / arterial road interface to be managed as outlined in Section 7.6.2. In the event that the ramp queue will exceed the available ramp storage, a pre-specified ramp exit flow can be activated to increase the metering rate. This ramp exit flow value needs to be determined to avoid an excessive inflow of traffic to the mainline that may trigger flow breakdown. Although the system has some capability to increase ramp flow it may not prevent queuing onto the arterial road.

During design where queues are expected to extend onto the arterial road on a regular basis, the design may need to provide for detection of queues on the arterial road and/or include provisions to accommodate queue overflows as outlined in Section 8.2.2.

The evaluation of ramp queue overflow may also need to consider the capabilities of the road network to accommodate trip diversions (refer to Section 3.3). Where significant volumes cannot be managed on an existing or proposed entry ramp / arterial road approach, further consideration may need to be given to providing a freeway or entry ramp design with greater storage or higher capacity.

8.2.2. Treatment Options

Some drivers will adapt to changing freeway accessibility and modify their travel patterns (route or time of travel). Therefore significant physical works should only be considered where route diversions are not feasible or where they have proven to be insufficient.

Real time information signs (RC3) as described in Section 6.4.12.3 and Section 7.7 are provided in advance of the right and left turn lanes as part of the ramp signal design. Information provided includes travel time and advice regarding incidents and freeway condition. Where ramp overflows and long delays are expected motorists may choose to take an alternative route.

To manage ramp queue overflow traffic, the following treatment options may need to be considered.

1. Interfacing between the freeway ramp signal system and the SCATS system. Control actions can then be initiated within the SCATS intersection controller.
2. Treatments to manage the right turn traffic entering the ramp include:
 - a) Modify the right turn signal phase times to restrict traffic entry.
 - b) Skip the right turn phase during affected times.
 - c) Extend the storage for right turning traffic. This could involve extending the turn lane(s) or providing double turning lanes, as appropriate.
3. Treatments to manage the left turning traffic entering the ramp include:
 - a) Providing or extending left turn lane storage to ensure queuing is clear of through traffic lanes;
 - b) Ensuring appropriate equity between the left and right turning demands:
 - Provision of signals on a left turn slip lane. This treatment is more likely to be needed with a Type 1 left turn entry (refer Section 6.4.10.3) or if there is an imbalance between the left and right turn flows with a high left turn volume.
 - Restricting left turn overlap times.
 - Installing a red left turn arrow.

The implementation of these measures has the potential to worsen queues on the arterial road and should only be considered where a demonstrated need exists.

4. Modify the phase times at other arterial road intersections to provide for traffic diversions.

8.3. Managing Exit Ramp Queuing

8.3.1. Potential Mainline Problems

Traffic flow on the freeway mainline is affected when traffic queues on an exit ramp extend back to block the left lane of the freeway or cause traffic to slow down prior to exiting as shown in Figure 8.1. This may cause flow breakdown on the mainline under certain conditions. It is also a significant safety concern for exiting traffic and for through traffic on the mainline. As indicated in Section 3.8, ramp metering of upstream entry ramps has limited effectiveness in addressing this problem.

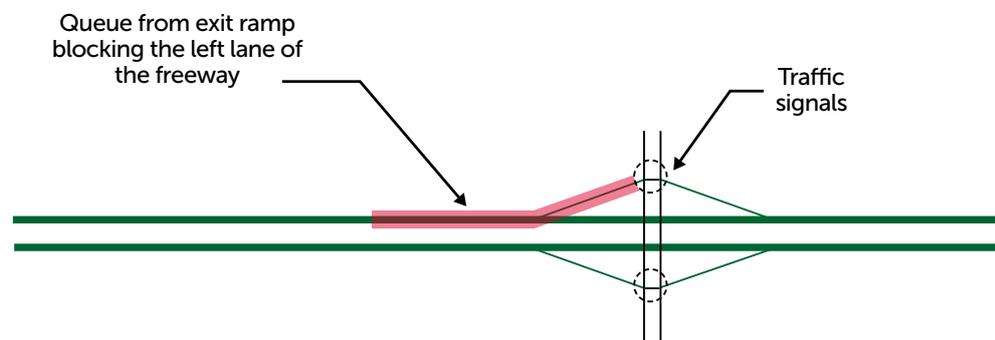


Figure 8.1: Exit Ramp Queue Affecting Freeway Flow

The problem of exiting vehicles causing flow problems on the freeway carriageway may be a result of:

- Inadequate intersection capacity at the arterial road intersection, e.g.,
 - Inadequate lane capacity on the ramp approach to the intersection e.g., insufficient number of lanes or length of turning lanes extending back from the intersection
 - Inadequate lane capacity on the arterial road approaches to the intersection which limit the time that can be allocated to the exit ramp, e.g., insufficient through or turning lanes
 - Stop or Give Way signs at the ramp exit
 - Unbalanced flows at a roundabout interchange.
- Inappropriate signal phasing and/or timings. The SCATS stop line detectors are able to determine if queues not satisfied at the end of a phase, but the SCATS system does not generally detect the length of the queue
- Traffic flow or capacity problems on the arterial road downstream of the interchange that may restrict traffic departing the intersection
- Adequate intersection capacity but inadequate ramp capacity to handle high exiting flows, e.g.,
 - A short ramp with insufficient length back to the mainline to accommodate queues
 - Insufficient width to enable the ramp to accommodate the exit flow, e.g., a single lane exit ramp where flow has increased to the extent that two lanes are required.

The safety of traffic related to exiting the freeway and the impact on capacity are important freeway operational concerns. Potential problems need to be addressed to prevent delay and road users' exposure to increased risk on account of poor exit conditions.

The objective of giving freeway operation priority over the arterial road network implies that the exit ramp flows should have priority over the entry ramp flows as the exit ramp flows can cause significant congestion on the freeway mainline, e.g., flow breakdown on a four lane freeway carriageway could affect a freeway flow of up to 8,000veh/h. Therefore, getting traffic off the freeway should be seen as the highest priority with other movements being given lesser priority.

8.3.2. Treatment Options

Traffic that is leaving a freeway needs to be managed to reduce the likelihood of exiting traffic interfering with mainline freeway traffic flow. The following actions may need to be considered, as appropriate, to address this problem:

1. Modify the arterial road traffic signal phase settings to facilitate a general increase in exit ramp traffic discharge.
2. Modify the arterial road traffic signal phasing to provide a specific exit ramp phase extension when the ramp queue is long. The queue length would be determined by the provision of a detector near the exit ramp nose to detect a queue extending beyond the ramp length. This data could be provided by:
 - Data station detectors near the exit nose. This data cannot be directly input into SCATS. However, the SCATS – STREAMS interface will be able to provide input when it is available. Existing detectors may be suitable or additional detectors provided if existing data station detectors are not suitably located.
 - Provide SCATS queue detection loops near the exit ramp nose to facilitate direct adjustment of the signal timings;

3. Increase the intersection capacity by providing:
 - Additional lanes on the exit ramp approaching the intersection to facilitate the discharge of more traffic within the available phase time. This may include additional right turning lanes, left turning lanes or a left turn slip lane at the signals
 - Additional lanes for through and/or turning traffic on the arterial road at the traffic signals. This can reduce overall delays and enable reallocation of time to the exit ramp signal phase
 - If the intersection is not signalised, replace Stop or Give Way control with new traffic signals to facilitate the discharge of exiting traffic.
4. Where a roundabout is provided at the arterial road intersection, provide roundabout metering signals to facilitate exit ramp egress
5. Considering downstream improvements on the arterial road to enable traffic to clear the intersection, e.g., signal linking or capacity improvements
6. Increase the ramp length to accommodate longer queues
7. Increase the number of exiting lanes from the freeway mainline and the ramp width
8. Allow exiting vehicles to queue on the emergency stopping lane. Dynamic queue-activated signing may need to be provided or static signs permitting the use of the shoulder at appropriate times.

8.3.3. Exit Ramps Design Storage

The provision of adequate exit ramp storage for new or upgraded freeway exit ramps is desirable to avoid the problems of exit ramp queues extending back and interfering with mainline freeway traffic flow. Desirable design standards include full length right turn and left turn lanes to accommodate 95th percentile queues.

