Monitoring local traffic levels

Introduction

1. The purpose of this document is to offer general advice on monitoring traffic locally. It is based on advice contained in the Traffic Appraisal Manual (TAM) and other documents used by the Department of Environment, Transport and the Regions (DETR) and the Highways Agency (HA). It also borrows extensively from Traffic Advisory Leaflet 1/99 entitled "Monitoring Local Cycle Use" and the 1998 Operational Requirement document used in DETR's contracting out of manual counts.

Available Methods of Measuring Traffic Flows

2. There are a number of ways that traffic information can be collected and used. These include the following:

    - **National data.** DETR's National Traffic Census provides comprehensive traffic statistics for about 11,000 major road links in England, about 9,000 of which are principal road links. These are based on 12-hour manual counts extrapolated using national factors to produce estimates of annual average daily flows (AADFs). There are also traffic flow estimates for 2,000 randomly-selected minor road sites which are all counted once a year. These give a broad indication of trends within regions, but there are too few of them to provide reliable information on trends at LA level. Both major road and minor road information can be obtained for a small charge (£50 plus £1 for full details of each site).
    - **Automatic Traffic Counters (ATCs)**. ATCs are most useful where traffic levels are more variable over the course of a day, week or year than other sites. They are also useful for links where traffic flows vary across the length of a link and where a DETR count could be misleading. ATCs could also be used where road changes are anticipated and where precise and continuous traffic data are needed. (Details of the different types of ATCs are given below)
    - **Manual Classified Counts (MCCs)**. MCCs are most useful where there is interest in the mix of traffic, as even the best ATCs have difficulties in distinguishing between some types of vehicle. For results to be statistically significant a number of counts are needed and this can prove expensive. In general, these counts should be undertaken on 'normal' weekdays outside the summer and winter months. Factors to extrapolate 12-hour counts into AADFs can be obtained from DETR. MCCs carried out as junction counts can provide useful information about traffic flows and how these may change in response to road infrastructure developments.
    - **Destination surveys**. Useful information on the impact of traffic initiatives may be obtained by counting parked vehicles or vehicle drop-offs and pick-ups at stations, workplaces, schools, shopping centres, etc.. If total monitoring of all such places is not possible, then ideally a stratified sample should be obtained, e.g. a representative number of schools.
    - **Interview Surveys**. The second LTP paper covers this type of survey.

3. Choices within the categories of automatic and manual methods are discussed below.

Automatic Traffic Counting Equipment

4. There are three types of ATC capable of measuring traffic flow. The advantages and disadvantages of each are discussed briefly below. Increasing the sophistication, such as using vehicle classification, will increase the costs for all three types :-

    - **Piezoelectric Counters**: Piezoelectric counters work through the principle of the strain gauge, in that the pressure exerted by a wheel on an embedded strip is converted into an electrical signal and recorded by a central control unit. Given that the characteristics of the

pressure, and hence the signal, generated by different classes of vehicle varies, it is possible to identify any particular type of vehicle in mixed traffic conditions. The counters are relatively expensive, costing up to £5,000 each. However, whilst they are at least 95% accurate in the short-term, this can reduce significantly due to wear on the strip. This type of sensor is used by DETR to count traffic at their continuous monitoring sites.

- **Induction Loops**: Inductive loops consist of a coiled wire buried in the road generating a small localised magnetic field. The size and shape of the loop is designed to register the wave form generated by the passage of a metal object through the magnetic field. The counter unit records the result. Inductive loop sites are relatively inexpensive, costing about £1,100 each. They require little maintenance, and are up to 95% accurate when installed correctly. Inductive loops are the most common method of counting general traffic over a long period.
- **Pneumatic Tube Counters**: A tube counter consists of a rubber tube connected to a counter unit. A vehicle depresses the tube, causing a pneumatic pulse to be sent to the counter unit. Whilst the capital cost of this system is relatively low, the equipment often requires frequent inspection and maintenance as a result of damage by vandals and from high traffic volumes. A pair of tubes can also provide additional information on vehicle speed and direction. The equipment at new sites should be calibrated using data from manual classified counts. Thereafter, this exercise should be repeated from time to time to ensure continued accuracy of the data.

Manual Count Devices

5. There are three main ways of recording traffic manually. They are as follows:

    - **Pencil and paper recording**. Suitable boxes with a separate sheet for each hour counted can be checked off as traffic passes. DETR has generally abandoned this method, as there are difficulties in observing the traffic whilst continuously having to look at the sheet to ensure that the marks have been placed in the right box.
    - **Clickers**. These are simple devices which can be used to record different types of vehicle, whilst still observing the traffic. Each click should be audible, thus reassuring the enumerator that the vehicle has been registered. Information from the clickers needs to be recorded on a sheet of paper after each hour of counting, before being reset.
    - **Electronic hand-held counters**. These are small devices which have various keypads that are pressed each time a vehicle passes. These can cost about £xxx each, and in experienced hands these give the best results. However, users do need to be experienced in their use, since there is no audible click when a key is pressed and the keys can be close together.

Advantages and disadvantages of ATCs and MCCs

6. It is true that an automatic counter running continuously without a break over a full year will provide an almost perfect estimate of total motor traffic at that point in the network. This is something that a grossed-up, 12-hour count can never provide. Automatic counters are much better at providing data for traffic travelling at unsocial hours, such as in the middle of the night. They are also relatively unaffected by unexpected, short-term influences, such as traffic accidents, affecting flow. However, there are a number of ways in which manual counts are better than automatic counters. These are listed below.

    - Manual counts can be cheaper per site;
    - ATCs, especially piezoelectric counters, are prone to breakdowns and it is always difficult to impute traffic estimates for missing periods;

- Many ATCs do not record all two-wheeled traffic, especially pedal cycle traffic. Also, pedal cycles can avoid tubes set in the road and will be missed entirely if they travel along the foot pavement at the site;
- MCCs are better at distinguishing between vehicle types, particularly between light goods vans and rigid two-axle goods vehicles;
- ATCs cannot measure traffic levels at slow speeds.

7. In order to supplement the DETR data available, most authorities will want to carry out traffic counts in their area. Indeed many authorities are already doing this. In most cases, they will want to carry out a mixture of manual and automatic counts. The choice will depend on the relative importance on the factors described in the previous two paragraphs.

Other considerations

Where to count

General: Some local authorities have found it helpful to use temporary surface fixed counters, or to undertake short manual counts in order to test the suitability of a site before installing a permanent counter.

Strategic: The sites should contribute to the monitoring programme and not be selected on the basis of convenience alone.

Local: The site layout and traffic characteristics should suit the monitoring equipment chosen.

High Traffic Flows: Sites with very low traffic flows should normally be avoided especially when undertaking MCCs, as these can be badly affected by short-term changes in traffic levels. This will minimise the variability of the data over a given period of time.

Counting All Traffic: As far as possible, sites should be chosen where it is difficult for road users to bypass the counter. For instance if road calming is implemented on a major road, then traffic on parallel, possibly minor, roads should be counted.

Junctions, Bends and Gradients: Some ATCs are not capable of counting traffic travelling at less than 5mph. Therefore, sites at uphill gradients, bends or junctions should be avoided.

Electrical Interference: Inductive loops should not be positioned close to potential sources of electrical or radio interference. Metal bridges, buried cables, rail lines, etc can adversely affect the data from an inductive loop.

Power Supply: Where electrical interference is not an issue, permanent ATC sites should have access to a mains power supply. Sites running on battery power can be more expensive in the long term. However, some battery changes may be carried out during routine maintenance visits, to minimise running costs.

What to count

Cars account for about 85% of all traffic and so simple ATCs which measure total motor vehicle traffic or just short and long vehicles can be acceptable. Where there is interest in the mix of traffic, then more sophisticated ATCs may be needed. However, even the best ATCs have difficulty in identifying pedal cycles and two-wheeled motor vehicles and in distinguishing light goods vans correctly. for those sites where there is interest in all the types of vehicles using the road, especially the lighter modes of transport, MCCs must be undertaken.

Eleven type of vehicle are counted by DETR. They are described in words in Annex 1. Photographs of vehicles that are difficult to classify can be provided on request.

When to count

Unless high intermittent peak flows are envisaged (e.g. at schools, factories, etc), daily flows should be recorded. Hourly flows should also be recorded, since this would be compatible with other traffic data.

Periods shorter than this may be useful for junction or signal design purposes. If roadworks are planned for the road to be surveyed, then the planned count should be postponed until traffic levels return to normal. Even on the day of the count, it may be necessary to abandon a count if a major road accident or traffic incident affects the flow significantly.

Manual counts should normally be conducted for twelve hours between 7am and 7pm. This is because DETR produce national expansion factors which can be used to estimate traffic on an average day of the year. In some cases shorter counts may be used, e.g. to check the effects of an initiative to reduce morning peak flows.

How many days to count? Short term counts may be used to estimate long term traffic flows. The quality of this estimate is dependent upon the following:-

The accuracy of the counters.
The length of the count period - longer the better.
The size of the flows - bigger the better.
The day to day variability of the flows.

In order to detect changes in traffic flows accurately, a statistically significant number of counts need to be carried out. The information in the table below, derived from national manual traffic count data, can be used as a first step towards selecting an appropriate sampling programme. For example, to detect a change of 3 per cent at a site with an average flow of 20,000 vehicles a day, at least 16 manual counts would need to be carried out – perhaps 8 in the base year or period and 8 in the final year/period. These calculations are given for confidence limits of 95%.

For monitoring traffic in an area, the same table can be used. However, the table assumes that each count is independent of the others. Local authorities monitoring traffic at more than one site should ensure that the counts in one year are conducted at different times of the year (in neutral months) and on roads that are as geographically different as possible. Obviously counting at two points near to each other on the same road gives less information about traffic in the area than two points on opposite sites of the area to be covered.

	Number of counts required to measure a change of:					
Average flow at site	1%	2%	3%	4%	5%	8%
5,000	188	47	21	12	8	3
10,000	172	43	19	11	7	3
15,000	157	39	17	10	6	2
20,000	148	37	16	9	6	2
30,000	143	36	16	9	6	2
40,000	134	33	15	8	5	2

Time of year to count. When monitoring traffic flows, and until such data are available, the following points should be kept in mind:-

- Count when flows are normal.
- Count during British Summer Time..
- For most sites, count outside school holidays, but for monitoring leisure sites counting during the holidays may be more appropriate.
- Comparison counts should be undertaken at the same times of the year.

DETR conducts counts between mid-March and mid-July and between mid-September and end-October. The exact dates are given in Annex 2. LAs carrying out counts on any of these dates will be able to obtain suitable expansion factors to gross up their traffic figures to AADFs.

Who to do the counting

Recently-retired persons with local knowledge make the best and the most reliable enumerators. Students tend not be so conscientious and, in general, should not be used.

Monitoring Overall Traffic levels

8. There are two ways to monitor traffic trends in a particular area. The first is to set up a system of cordons or screenlines, incorporating MCCs, on a regular basis, at similar times of the year. The data derived from this can be supplemented with that obtained from long-term ATCs. The main disadvantage of this approach is that road users may "leak through" the cordon by using minor roads. This may lead to underestimates of changing traffic levels and uncertainties over observed changes through time. Nevertheless, cordon or screenline counts are probably the most practical way for a local authority to monitor trends from one year to the next, particularly if particular initiatives are carried out in the are.

9. An alternative to the above is to take a random, or at least stratified random, sample of all roads, to estimate the current traffic levels, and then repeat these counts at suitable intervals. This is the method used, in part, by the DETR to estimate national traffic. Given an estimate of the vehicle flow on any given road type, and knowing the length of road of that type, then the total vehicle kilometres for that type of road in the area can be calculated. Repeat surveys could then be used to estimate changes in vehicle kilometres. The main drawback with this method is that the uncertainty of year-by-year values could so great as to mask all but the largest changes in traffic levels.

Recommendations

10. The following actions are recommended:

    - Use DETR data where available to provide a backdrop to overall traffic trends in the local authority;
    - Continue with counts already in place to give a longer-term view of traffic in the area, bearing in mind that these may not provide representative estimates of traffic trends in the area if they were established for particular monitoring purposes.
    - Use ATCs to monitor parts of the major road network that are important to the LAs, which are not covered frequently by DETR manual counts or where the DETR site is too far from the desired location for the count;
    - Carry out manual counts on minor roads, especially those likely to be affected by initiatives, backing these up by the use of cheap, pneumatic tube counters.
    - Carry out parking and other observation studies to provide evidence of the effects of special plans to reduce car traffic, e.g. green plans for school journeys.

ANNEX 1

Vehicles separated classified by DETR

The following vehicles are separately identified for each hour of counting in the DETR manual counts:

Pedal cycles
Two-wheeled motor vehicles
Cars and Buses
Buses and coaches
Light vans
Rigid 2-axle goods vehicles
Rigid 3-axle goods vehicles
Rigid 4-axle goods vehicles
3 or 4-axle goods vehicles (articulated or with trailer)
5-axle goods vehicles (articulated or with trailer)
6 or more axle goods vehicles (articulated or with trailer)

The definitions for the above vehicle types are given below:

Pedal cycles

Includes all non-motorised cycles.

Two-wheeled motor vehicles

Includes motorcycles, scooters and mopeds and all motorcycle or scooter combinations.

Cars and taxis

Includes estate cars, all light vans with windows to the rear of the driver's seat and vehicles which can accommodate not more than 9 seats. Three-wheeled cars, motor invalid carriages, Land Rovers, Range Rovers and Jeeps are included. Cars towing caravans or trailers are counted as one vehicle.

Buses and coaches

Includes all public service vehicles and works buses other than vehicles with less than 10 seats.

Light vans

Includes all goods vehicles up to 3,500 kgs gross vehicle weight. This includes all car delivery vans and those of the next larger carrying capacity such as transit vans. Included here are small pickup vans, three-wheeled goods vehicles, milk floats and pedestrian controlled motor vehicles. Most of this group are delivery vans of one type or another.

Goods vehicles:

Rigid with two axles

Includes all rigid vehicles over 3,500 kgs gross vehicle weight with two axles. Includes ambulances, tractors (without trailers), road rollers, box vans and similar large vans. A two axle motor tractive unit without trailer is also included.

Rigid with three axles

Includes all non-articulated goods vehicles with three axles irrespective of the position of the axles. Excludes two axle rigid vehicles towing a single axle caravan or trailer. Three axle motor tractive units without a trailer are also included.

Rigid with four or more axles

Includes all non-articulated goods vehicles with four axles, regardless of the position of the axles. Excludes two or three axle rigid vehicles towing a caravan or trailer.

Articulated with three axles (or with trailer)

Includes all articulated vehicles with three axles. The motor tractive unit will have two axles and the trailer one. Also included in this class are two axle rigid goods vehicles towing a single axle caravan or trailer.

Articulated with four axles (or with trailer)

Includes all articulated vehicles with a total of four axles regardless of the position of the axles, i.e. two on the tractive unit with two on the trailer, or three on the tractive unit with one on the trailer. Also includes two axle rigid goods vehicles towing two axle close coupled or drawbar trailers.

Articulated with five or more axles (or with trailer)

This includes all articulated vehicles with a total of five axles regardless of the position of the axles. Also includes rigid vehicles drawing close coupled or drawbar trailers where the total axle number equals five and articulated vehicles where the motor tractive unit has more than one trailer and the total axle number equals five.

Articulated with six or more axles (or with trailer)

This includes all articulated vehicles with a total of six or more axles regardless of the position of the axles. Also includes rigid vehicles drawing close coupled or drawbar trailers where the total axle number equals six or more and articulated vehicles where the motor tractive unit has more than one trailer and the total axle number equals six or more.

Articulated goods vehicles

Please note, it is important when a goods vehicle is travelling with one or more axles raised from the road (sleeping axles or hobos) then the vehicle is classified into the class of the number of axles on the road, and not to the class of the total number of axles.

ANNEX 2

Days of neutral weeks in 2000

1. Dates for counting are determined by internationally-agreed week numbers[1]. This will mean that counts in each year will be related to particular days of particular weeks.

Week numbers	Exclusions	Description of counts	2000 dates	Number of neutral days counted
1		No counts		
2 to 10.8	5 days - Week 8 or 9 (half-term week)	Summer/Winter counts	10 Jan to 16 Mar	-
12 to 21	11 days - Week before and week after Easter, May Bank Holiday Monday	Neutral month counts up to late May Bank Holiday week[2]	17 Mar to 26 May	40
22	-	Summer/winter counts	29 May to 2 Jun	
23 to 28	-	Neutral month counts	5 Jun to 14 Jul	30
29 to 37	1 day - August Bank Holiday Monday	Summer/Winter counts	17 Jul to 15 Sep	
38 to 43.4	5 days - School term break	Neutral month counts	18 Sep to 31 Oct	27
43.6 to 50	-	Summer/Winter counts	1 Nov to 15 Dec	
51 to end		No counts		

[1] Week 1 of a year is the week that contains the first Thursday of the year.

[2] May Bank Holiday week in non-leap year is always in week 22.