DESIGN GUIDELINES FOR SUBDIVISIONAL STREETWORKS

QUEENSLAND STREETS

PRODUCED BY:	The Institute of Municipal Engineering Australia, Queensland Division
FUNDED BY:	"Residential Regulation Review Program" administered by the Queensland Department of Housing, Local Government and Planning
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MINISTER FOR HOUSING, LOCAL GOVERNMENT AND PLANNING

The Hon. Terry Mackenroth M.P.
Member for Chatsworth

MINISTER'S FOREWORD

FOR

QUEENSLAND STREETS

The State Government is committed to developing better communities by improving the standard and design of residential land and housing.

The Australian Model Code for Residential Development (AMCORD) was developed to help achieve this goal and I am pleased that it is being used by an increasing number of local authorities throughout the State.

AMCORD however was always intended to be supplemented by further research and guidelines as they were developed.

Queensland Streets is one such publication. It extends the work initiated by AMCORD by providing additional technical design criteria in the important area of residential street design.

By providing detailed, practical guidance, this publication will be a valuable resource for local authorities, subdivision designers and engineers.

I congratulate the Institute of Municipal Engineering on the development of these guidelines and encourage local authorities and designers to use the guidelines in creating safer, more enjoyable and more affordable communities.

TERRY MACKENROTH

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The Institute of Municipal Engineering Australia - Queensland Division is proud to have been instrumental in initiating the development of these Guidelines - Queensland Streets. Through our Members' close involvement with the land development process, there has been a recognition for some years of the need to revise standards with the aim of producing a uniformly applicable set of guidelines for subdivisional roadworks. With the publication in 1989 of AMCORD the advantage was taken of a grant to finalise the document which incorporates AMCORD philosophies.

The Institute is indebted to the tireless effort over many years of those Members who have given of their time towards this project. In particular, our thanks go to the Steering Committee Members - Chris Lawson, Al Milvydas, Dennis Yardley and David Crane. A special thanks also go to Clive Jenkins of Weathered Howe Pty Ltd for his dedication and expertise. Thanks are also extended to the Department of Housing, Local Government and Planning Staff - particularly Warren Rowe and Steve Conner for their support and assistance in final drafting of the document. Finally, the contribution by Redland Shire and Logan City through engineers Phil Hennessey and Peter Way is most appreciated.

It is hoped that those utilising these Guidelines gain the benefit of the work that has gone into their preparation and that the subdivision of land process will be the major beneficiary, fostering improved efficiency and economy in the development process.

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Jack P Garside
President - IMEAQ

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On behalf of the Member Councils of The Local Government Association of Queensland I wish to congratulate the Institute of Municipal Engineering on the production of the Design Guidelines for Subdivisional Streetworks.

This document will be of tremendous benefit to Local Government and being aligned as it is to AMCORD principles, could provide the practical information sought by so many Authorities, particularly those faced with residential development.

The considerable amount of time and effort which has been expended to provide these guidelines is indicative of the commitment of Mr. Garside and the members of his Institute to ensuring that Local Government performs in a creditable manner and provides infrastructure at an affordable and efficient standard.

ACKNOWLEDGMENTS

This Code is based principally on:-

THE AUSTRALIAN MODEL CODE FOR RESIDENTIAL DEVELOPMENT - **AMCORD** prepared by the Model Code Task Force of the Joint Venture for More Affordable Housing, and an initiative of the Commonwealth Department of Industry, Technology and Commerce.

However, reference has also been made to a number of other sources, viz:-

AMCORD - BACKGROUND REPORT, ANDREW O'BRIEN AND ASSOCIATES, MAY 1990.

AMCORD - EXPLANATORY REPORT ON ITS DEVELOPMENT AND APPLICATION
HANS L. WESTERMAN SEPTEMBER 1989.

ROAD CHARACTERISTICS FOR RESIDENTIAL SUBDIVISIONS
POK-POY AND KNEEBONE PTY LTD - NOVEMBER 1988.

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DEPARTMENT OF HOUSING AND CONSTRUCTION - MAY 1984.

THE STREETS WHERE WE LIVE
LAND COMMISSION OF N.S.W. - 1984.

PLANNING AND ROAD DESIGN FOR NEW RESIDENTIAL SUBDIVISIONS
DIRECTOR GENERAL OF TRANSPORT SOUTH AUSTRALIA.(STAPLETON
TRANSPORTATION PLANNING PTY LTD) - 1988.

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MINISTRY FOR PLANNING AND ENVIRONMENT - NOVEMBER 1988.

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SECTION 1.0 - INTRODUCTION

INTRODUCTION 1.0

1.1 PURPOSE OF THE GUIDELINES

The purpose of these Guidelines is:-

- To provide the basis for a uniform standard of residential streetworks design, incorporating "state-of-the-art" principles and techniques, for use throughout Queensland.

- As a technical support to **AMCORD**, to provide the more detailed design criteria necessary for the design of streetworks for residential developments in accordance with AMCORD principles.

1.2 RELATIONSHIP TO AMCORD

AMCORD BACKGROUND

AMCORD (Australian Model Code for Residential Development) was prepared by the Model Code Task Force of the Joint Venture for More Affordable Housing, a Commonwealth Government Initiative. The first edition was issued in June 1989 and the current (second) edition, incorporating community and industry input from the first edition, was issued in November 1990.

Since then, the principles of AMCORD have received general acceptance from Government Departments, Local Authorities, the development industry and the community generally, in recognition of the potential offered by its provisions for better quality and more cost efficient residential development.

In Queensland, several Local Authorities have already incorporated the AMCORD Performance criteria into their Planning Schemes, and it is foreseeable that within a short period the majority of residential development in Queensland will be carried out in accordance with AMCORD criteria.

AMCORD SCOPE

AMCORD provides a **complete Code** for residential development of up to two (2) stories in height, covering all aspects of development, such as:-

- Allotment size and orientation
- Building siting and design
- Private and Public Open Space
- Vehicle Parking
- Streetscape
- Transport Networks
- Street Design and Construction
- Pedestrian and Cyclist Facilities
- Utilities provision and location
- Drainage network.

AMCORD AND QUEENSLAND STREETS

By the nature of its broad coverage of all aspects of Residential Development, AMCORD cannot cover all the details of every aspect, sufficient for preparation of a detailed development design.

"Queensland Streets" provides the necessary additional technical design criteria in the specific field of Street Design, and some related aspects.

"Queensland Streets" is therefore to be considered as a supplement to AMCORD, <u>not</u> as a substitute for AMCORD.

"Queensland Streets" evolved in parallel with AMCORD, based largely on the same sources of inspiration and research as AMCORD, as well as upon AMCORD itself.

There are no significant differences in philosophy in regard to basic principles between the two Codes, and hence **the Performance Criteria are consistent between the two.** However, "Queensland Streets" takes the Performance Criteria into more detail, due to its more specialised nature.

The relationship between AMCORD and "Queensland Streets" is emphasised by the inclusion of the relevant provisions of AMCORD, together with additional specific criteria, in the Objectives and Performance Criteria for each design element.

There are some minor variations in **"Deemed-to-Comply" criteria** between the two Codes, but as the Deemed-to-Comply criteria are by nature advisory rather than mandatory, these variations do not represent any conflict between the two documents. In fact, the variations serve to illustrate the inherent flexibility of the **Performance Oriented** approach of both Codes.

In several instances the variations represent the adaptation of an Australia-wide code to specific Queensland practice.

1.3 BACKGROUND TO THE GUIDELINES

PRESENT SITUATION

Even with the publication of AMCORD in 1989 there is still no uniform standard in Queensland for the design of subdivisional road and streetworks, and while AMCORD principles are rapidly achieving general acceptance, Local Authority street design standards have been slower to change.

Most of the major Local Authorities still have their own standards, and these standards may differ quite widely from Authority to Authority.

ADVANTAGES OF A UNIFORM STANDARD

A uniform subdivisional streetworks standard can result in improved efficiency and economy in subdivisional development, and hence reduced housing costs, through two avenues:

(a) Efficiency from standardisation; and

(b) Introduction throughout the State of modern, cost effective techniques.

The lack of subdivisional engineering standards common to all Local Authorities in the state has been a problem to Councils, Consulting Engineers, Developers, Contractors and Manufacturers:

- **TO COUNCILS** in that in many cases their engineering staff have neither the time nor the experience to formulate effective standards, and in the absence of established standards they must deal with all submissions on a "one-off" basis.
- **TO CONSULTING ENGINEERS AND DEVELOPERS** in dealing with several Local Authorities, with either differing standards or with no firm standards at all, resulting in uncertainty as to what will be acceptable to the Council.
- **TO CONTRACTORS AND MANUFACTURERS** in having to provide goods and services to suit differing standards e.g. kerb and channel moulds, gully pit and manhole formwork, gully grates, etc.

A uniform standard can overcome these problems and thereby improve both efficiency and economy.

ORIGIN OF THE GUIDELINES

The South-Eastern Group of the then Local Government Engineers Association of Queensland (now the Institute of Municipal Engineering Australia, Queensland Division [I.M.E.A.Q.]) recognised some years ago the desirability of adopting uniform engineering standards within the region, and established working committees to pursue this objective in the fields of Roadworks, Stormwater Drainage, and Standard Drawings. While the Standard Drawings project was successfully completed, the Roadworks and Stormwater Drainage projects were not finalised, due to the work load constraints of the committee members' normal duties.

The previous Roadworks sub-committee had decided that the Albert Shire Council Subdivisional Roadworks Standard, which had been widely adopted in south eastern Queensland, would provide a suitable basis for a uniform standard and had carried out a considerable amount of work along this line.

However, since the compilation of the Albert Shire Standard in 1973, there have been a number of innovations in this field, particularly in regard to safety and amenity in residential streets, and this and other existing standards are considered to be now overconservative and restrictive, and in some respects actually counter-productive.

By far the most significant of the innovations was AMCORD, and after its publication in 1989, funding became available under the **Residential Regulation Review Program** for projects which would promote the adoption of the recommendations of AMCORD.

The I.M.E.A.Q. saw this as an opportunity to bring the previous work in this field to fruition, and through the sponsorship of Logan City Council and Redland Shire Council, and the support and assistance of the Queensland Department of Housing, Local Government and Planning, obtained a Grant for the preparation of a "Standard Design Code for Subdivisional Roadworks".

PREPARATION OF THE GUIDELINES

The preparation of these Guidelines was carried out under the direction of a Steering Committee of Local Government engineers and a representative of the U.D.I.A.

Consulting Engineers, Weathered Howe Pty Ltd, were engaged to carry out the project, with their Civil Engineering Manager, Mr Clive Jenkins as Project Manager due to his earlier experience with the Albert Shire Council standard and the previous L.G.E.A.Q. standards working committee.

The Department of Housing Local Government and Planning assisted with advice on the incorporation of AMCORD provisions, and carried out the formatting and setting up for publication.

1.4 CONTENTS AND APPLICATION

SCOPE

As previously noted, the Guidelines should be considered as an **extension** of AMCORD, providing the necessary additional detailed information on all aspects of subdivisional streetworks to form a **practical Design Guide,** for the use of the Consultant and his technical staff in preparation of a detailed engineering design, and by Local Authority staff in the checking of a submitted design.

However, as they will be used largely by technicians specialising in engineering design, who may not be familiar in detail with AMCORD, the Guidelines are written as a self-contained document embodying both theory and recommended practice.

THEORY AND ASSUMPTIONS

The Guidelines do not presume to be a text book on the subject of Subdivisional Streetworks, but for credibility it has been considered necessary to include in some detail the background theory and assumptions on which the Guidelines' recommendations are based. This is particularly so where the recommendations differ considerably from common current practice.

SEQUENCE OF SUBJECT MATTER

While most other similar publications consider first the requirements for the Major Road system, and work downward to the local street, the Guidelines differ in the sequence of subject matter by considering firstly the requirements for the **individual Residential Street.**

This sequence is considered to be:-

- Consistent with the stressed importance of achieving a high environmental quality in every Residential street.

- Logical in that the form of the Residential precinct is largely a product of the requirement for limiting traffic volume in every residential street.

APPLICATION

The Guidelines are envisaged as having application:

- Throughout the whole of Queensland;

- For all forms of low and medium density residential development e.g. detached dwellings, duplexes, attached housing;

- For all forms of titling, e.g. Freehold, Group Title, Building Units Title, with streets either public roads or in private ownership.

- For both new "broad-acre" development and infill within existing developed areas where appropriate.

However it is proposed to be an **Advisory** document only, to be adopted as policy at each Local Authority's option, with or without modification.

1.5 PERFORMANCE ORIENTATION

PRESCRIPTIVE STANDARDS

Most traditional codes and standards are "prescriptive", specifying definite criteria, numerical or otherwise, which must be complied with.

Such standards are simple to use for design, and for checking submitted designs for compliance. However, the bases for the design criteria are generally not stated, and in many cases their origin may be historical and of doubtful current validity, or the criteria may not be appropriate to the specific circumstance.

PERFORMANCE STANDARDS

On the other hand, the Guidelines, together with AMCORD and several other recent codes, are "Performance Oriented", identifying the **Objectives** sought to be achieved, and the **Performance Crite-**

ria required to be satisfied in respect of each design aspect, allowing the designer a choice of methods to achieve the required results.

However, as a guide for the less experienced designer, and also to provide a possible "common ground" between designer and Local Authority, **"Acceptable Solutions"** are also provided for each design aspect.

By using **only** these criteria the Guidelines would become a "Prescriptive Standard".

DESIGNER OPPORTUNITIES

The Guidelines provide **great opportunities** for the designer to apply an innovative and cost-effective approach to streetworks design, without the "straight-jacket" of older prescriptive standards.

While the approach of using only the "Acceptable Solutions" criteria may be valid for minor, straightforward developments, or perhaps as a self-defence where the Local Authority attitude is unpredictable, it is hoped that it will **NOT** be the general means of applying the Guidelines.

More preferable is a true understanding of the intent of the **Performance Criteria** and satisfaction of these criteria by application of a design solution appropriate to the specific circumstances.

LOCAL AUTHORITY OBLIGATIONS

Use of the Guidelines by Local Authority staff for checking designs submitted by Consultants requires the exercising of a much more flexible approach than has been necessary for the application of "Prescriptive" standards.

Checking staff need to appreciate the following:

- The essential requirement is observance of the **spirit** of the Performance Criteria.
- "Acceptable Solutions", while generally acceptable, are **NOT** necessarily the only satisfactory design solution, and in many cases may not be the best, nor even an appropriate solution.
- "Acceptable Solutions" are **NOT** absolutes - "Commandments carved in stone". Considerable variation exists between figures quoted by the many expert sources, and quoted figures should be regarded as the mean value of a "grey band", rather than as absolute values.

As a guide, proposed designs which are within, say 10 to 15% of the Guidelines' "Acceptable Solutions" should not be arbitrarily rejected.

The above considerations imply that to satisfactorily check designs under these Guidelines requires a much greater exercise of engineering judgement than is generally the case with current "prescriptive" codes. This in turn implies that the staff involved in design checking require considerable technical experience in this type of work, preferably including practical design, and a maturity of technical judgement.

Senior Engineers will also need to be more directly involved in design checking in:-

- Setting broad policy guidelines;
- Initial discussion with Consultants, to agree on design concepts;
- Arbitrating between Consultants and Council checking officers on disputed issues.

1.6 INNOVATIONS OF THE GUIDELINES

MAJOR INNOVATIONS

Those familiar with existing Local Authority standards will note a number of significant variations between such standards and the recommendations of the Guidelines, the major variations being:-

(1) Approach

While existing standards are largely "Prescriptive", the Guidelines are "Performance Oriented", defining **Objectives and Performance Criteria** but allowing the designer choice of the method by which these objectives are to be attained.

However, **"Acceptable Solutions"** criteria are provided for those who are content to follow prescribed standards.

(2) Residential Street vs. Traffic Route

The Guidelines make a definite distinction between:-

- the **Residential Street**, whose major function is to provide access to the lots which front it, and

- the **Traffic Route,** whose function is to provide for the movement of traffic.

This is a marked departure from the "traditional" concept of a graduated road/street hierarchy.

(3) Reduced Vehicle Speed

In the interests of Safety, Amenity and Economy, the Residential Street, with the emphasis now placed on its access function, is designed for consistently lower vehicle speeds. This is achieved by tight geometric design e.g. reduced carriageway widths, reduced length of straight alignment, sharp curve radii, and the necessity to pause occasionally to give way to opposing traffic.

(4) Reduced Traffic Volume

The Guidelines place a definite upper limit on the acceptable maximum traffic volume on a Residential Street, recommending that if such traffic volume is exceeded frontage access to residential lots should be denied.

(5) "No-Access Collector Street"

Limitation of the maximum traffic volume on a Residential Street results in the need for a new class of **No-Access Collector Street.**

Such a street can be a financial liability and has problems of implementation. However, the **total** cost of streets and roads can still be less than at present, due to savings in construction costs which can result from amended standards in the majority of streets in the system.

ACCEPTANCE OF THE GUIDELINES

While most people will agree with the **principles** of reducing vehicle speed and traffic volume, some of the methods proposed, particularly reduction in carriageway width and restrictive street geometry, are potentially controversial.

Some members of the public, and even some elected Local Authority members and professional staff may perceive such changes to established standards as a retrograde step, possibly resulting in "sub-standard" development.

Points sometimes raised include:-

- "Proposed carriageway widths are too narrow", and
- "Inadequate provision for parking on the carriageway."

The Steering Committee is well aware of the existence of such reservations, and has therefore endeavoured to fully document the background to the recommendations.

However, while there will undoubtedly always be some differences of opinion on detail, it is believed that all will agree with the **principles** of the Guidelines, viz:-

- **Safety, Amenity, Convenience and Economy** for residents, street users, and the community generally, and
- **A better product at a more affordable price.**

1.7 GOAL AND OBJECTIVES

GOAL

The identified **Goal** of the Guidelines is to promote and encourage Subdivisional Streetworks design and construction practices which will provide an **Optimum Combination** of:-

- **Safety**
- **Amenity**
- **Convenience** and
- **Economy**

for subdivision residents, street users, and the community generally.

OBJECTIVES

The four major considerations stated in the **Goal** of the Guidelines, viz:-

Safety, Amenity, Convenience and Economy

are the **Primary Objectives.**

These are the Yardsticks against which all proposed design criteria are to be assessed.

Each of these **Primary Objectives** has a number of components, e.g.

SAFETY

- Road accident prevention (obviously the major component in the case of Streetworks design).
- Emergency vehicles access (fire and ambulance).
- Crime prevention ("Neighbourhood" planning; safe pedestrian routes).

AMENITY

- Traffic Noise reduction
- Visual Amenity
- Social Planning

CONVENIENCE

- Minimum travel distances to major destinations
- Minimum travel times in low-speed environment
- Legible street layout

ECONOMY

- Capital cost of subdivision construction
- Maintenance costs
- User costs

COMPROMISES

While the Primary Objectives are to a large degree compatible, there is often a potential conflict between the ideals of not only the Primary Objectives themselves, but within each of the Primary Objectives, e.g.:-

a) Street Layout excluding through Traffic

- Safety and Amenity vs. User Convenience

b) Pavement Thickness Design

- Capital cost vs. Maintenance Cost

The achievement of an **Optimum** design lies in the judicious balancing of the ideals of each Objective, to obtain the best overall solution - not just a science, but an art!

SECTION 2.0 - THE RESIDENTIAL STREET

PHILOSOPHY OF THE RESIDENTIAL STREET 2.1

FUNCTION OF THE STREET

The Residential Street serves a number of functions, viz.:-

ACCESS TO RESIDENCES
Motor vehicles - residents, visitors, delivery and service vehicles.
Cyclists
Pedestrians

PARKING
Visitors vehicles, and overspill of residents' vehicles, caravans and boats.

SOCIAL AND ACTIVITY SPACE
For neighbours to chat, and children to play.

SETTING & APPROACH
For the residences located on it, desirably with high aesthetic and amenity quality.

STORMWATER DRAINAGE PATH
Both underground and overground.

SERVICES LOCATION
For utility services to residences.

MOTOR VEHICLE V. THE REST

The only potentially incompatible street user within the above list is the **motor vehicle.**

Without the need to cater for its requirements the street could be a park strip, planted and landscaped, with a narrow pathway meandering between the trees - the ultimate in **safety, amenity and economy.**

Over the last several decades however, the motor vehicle has entrenched itself into our society to an extent where the validity of its perceived needs have been accepted with little question.

However, in the last few years the legitimate claims of other street users, and of residential amenity, have been recognised.

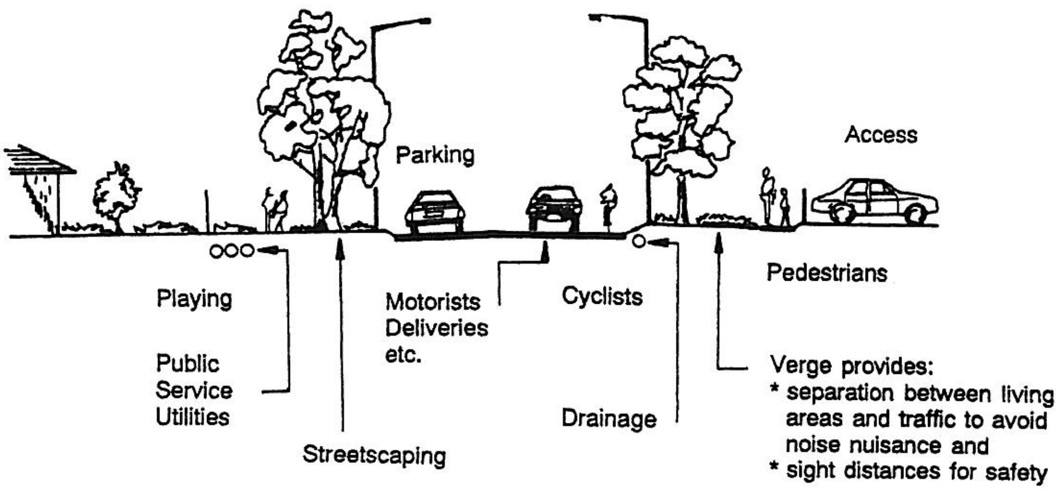
The challenge of contemporary Street Design is therefore to resolve these conflicting interests, or at least to reach an acceptable compromise.

ALTERNATIVE STREET DESIGNS

Several alternatives to the conventional street design have been utilised in the past, in an attempt to resolve this conflict, e.g.

- **"Radburn"** type subdivision, initiated in the U.S.A., used in Britain, and in Australia in Canberra, Adelaide and Sydney. This type of subdivision provides for virtual complete separation of the road system from the pedestrian/cycleway system, thereby enhancing **Safety.** However the cost of providing the two separate access systems is a minus for **Economy.**

- **Group Garaging** of cars at the street entrance, with pedestrian only access to dwellings, has been utilised, but in the Australian context of car usage would not be generally accepted due to a perceived lack of **convenience.**



THE FUNCTIONS OF A RESIDENTIAL STREET

- **The "Woonerf"** is a Dutch solution, which provides for maximum integration of the motor vehicle with other street users by using geometric design to achieve extreme speed restriction. Again, while highly successful in the European environment of high density urban development with relatively low car ownership, it is not directly adaptable to the typical Australian suburban situation.

COMPROMISE

Like it or not, the motor car is an integral and essential part of the typical Australian lifestyle, and therefore the most practical solution appears to be a modification of our accepted conventional street system to achieve a reasonable compromise between the perceived needs of the motor vehicle, and those of other street users.

The extent of this conflict of needs is a function of **Traffic Volume** and **Traffic Speed**.

The greater the traffic volume and speed the greater the detriment to the goals of Safety, Amenity, Convenience and Economy.

Safety:	Greater chance of accidents with volume, and increase in accident severity with speed.
Amenity:	Increased traffic noise and exhaust fumes.
Convenience:	Fewer opportunities for pedestrians to cross roads, and drivers to enter traffic streams.
Economy:	Greater construction costs to safely provide for increased traffic volume and speed.

The necessary compromise is therefore to limit traffic volume and traffic speed in Residential streets to a level which is reasonably compatible with the safety and amenity of other street users.

Above the limit of traffic volume where this is no longer acceptable, frontage of residential lots to the street should not be permitted.

TRAFFIC CHARACTERISTICS

VEHICULAR

Vehicular traffic in properly planned Residential streets is virtually all cars with some light delivery vehicles.
There is the occasional larger vehicle such as:-

- Garbage truck - weekly or bi-weekly
- Larger truck, with e.g. building materials
- Furniture van
- Resident's boat or caravan.
- Local bus service - rarely, and then on a major street only.

While these larger vehicles must be able to negotiate the street, their comparative rarity is such that it is not reasonable to design for their total convenience. Reduced speed and reduced passing clearances are therefore acceptable for the situation of a car passing a truck or bus, and still more so for the even rarer event of two trucks or buses passing.

PEDESTRIANS AND CYCLISTS

In the typical Low Volume - Low Speed traffic situation which should exist in most Residential streets, pedestrians and cyclists may be provided for on the carriageway on the basis of equal sharing with motor vehicles, subject to positive restriction on vehicle speed.

PHILOSOPHY OF TRAFFIC OPERATION

The basic principle of traffic operation in the low-volume, low-speed Residential street environment is that:-

Vehicles do not have unrestricted two-way movement at all times.

To provide such unrestricted movement, with uncontrolled parking on the carriageway, requires a carriageway width of approximately 10.0m minimum. While many existing fully residential streets do have carriageways of such width, they are quite unnecessarily wide, and undesirable from consideration of the traffic speeds they encourage.

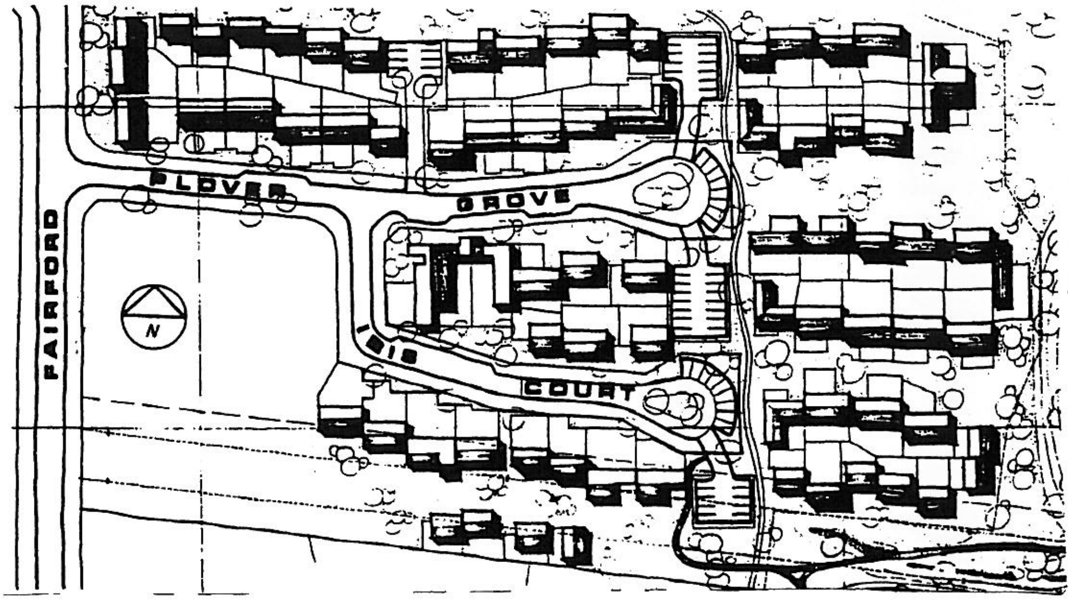
The present "standard" residential carriageway width of 8 m (approximately) does not provide unrestricted movement when two vehicles park opposite each other. In such circumstances, drivers do accept the slight inconvenience of having to slow down or briefly stop to give way to a vehicle coming the other way, particularly as it is quite likely to be a neighbour.

The expectation of having to slow or stop for a vehicle coming the other way will tend to keep speeds low, which is in accordance with the design philosophy for Residential streets.

For consistency, it is highly desirable for **all** Residential streets to be designed on this basis, to reinforce the difference in driver expectation, viz:-

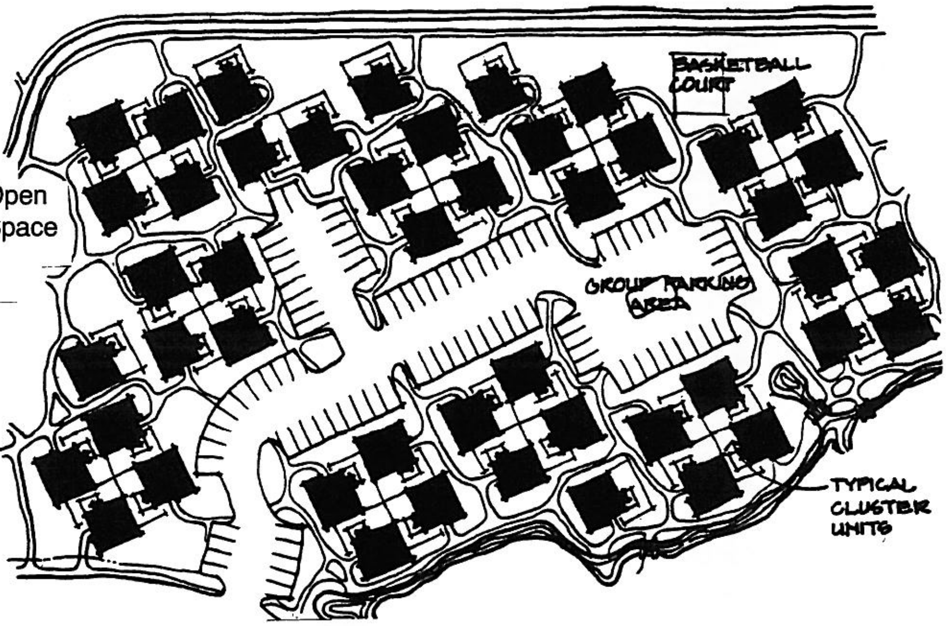
MODIFIED "RADBURN" LAYOUT—

"WESTLAKES" ADELAIDE, S.A.



GROUPED CAR PARKING—

U.S.A.



DUTCH "WOONERF"

Residential street - **Give way situations**

Traffic route - **Unrestricted two-way movement**

It is therefore considered both acceptable and desirable to have a "One-Moving Lane" situation in places (whether constructed that way or caused by parking of vehicles) **provided** that:-

- Passing opportunities are available at reasonable intervals; and
- The incidence of opposing vehicle meetings is not sufficiently frequent to cause unreasonable delays.

FUNCTIONS OF THE CARRIAGEWAY

The street carriageway therefore will have three functional components, as far as vehicles are concerned:-
- A single moving lane
- Provision for opposing vehicles to pass
- Provision for parked vehicles

The requirements in respect of each of these functions are dealt with in following sections.

CARRIAGEWAY LANES

In subsequent sections, carriageway width is referred to in terms of the number of "Lanes" e.g. **Single Lane, Two Lane, or Three Lane.**

However, this does **not** imply either that "lanes" are linemarked on the carriageway, nor that a particular width of the carriageway is dedicated to a particular purpose. In this the Residential Street differs from a major road, where "lanes" are formally delineated and generally dedicated to a specific use e.g. Through traffic lanes, Parking lanes, Turn lanes, Deceleration lanes, etc.

In general, the width of the Residential Street may at different times be used for moving vehicles (either direction), passing opposing vehicles, or for parked vehicles.

In this context "Single Lane", "Two Lane" or "Three Lane" therefore means a carriageway with a width designed to accommodate One, Two or Three vehicles within its cross-section, irrespective of whether those vehicles are moving or parked.

PHILOSOPHY OF THE RESIDENTIAL STREET

OBJECTIVES

* To provide a high level of safety for all street users;
* To provide acceptable levels of residential amenity and protection from the impact of traffic;
* To provide a reasonable level of convenience for all street users;
* To provide maximum possible economy of construction, consistent with the other objectives.

PERFORMANCE CRITERIA

* Limitation of traffic speed and volume in Residential streets to levels which are compatible with the safety and amenity of other street users and residents.
* Frontage of residential lots to be permitted only to streets where these limitations of traffic speed and volume can be attained.
* Limitation of carriageway width to the minimum necessary to satisfactorily provide for required traffic functions.

ACCEPTABLE SOLUTIONS

Conformity with the provisions of Sections 2.2 to 2.12 of these Guidelines.

TRAFFIC VOLUME 2.2

EFFECT OF TRAFFIC VOLUME

A high traffic volume in the Residential Street is detrimental to:-

- Safety-Increased risk of accidents
- Amenity-Loss of amenity due to increased noise and exhaust fumes
- Convenience-Reduced opportunities for entering traffic streams or crossing roads

One of the most significant effects of traffic volume in the Residential Street is loss of amenity due to **Noise.**

Assessment of a maximum acceptable limit for traffic noise is a very subjective matter, with various research and standards suggesting that this limit occurs anywhere between 1200 and 5000 vehicles per day. (See Figure 2.2.C)

However, **2000 to 3000** vehicles per day is the most commonly recommended range of maximum acceptable traffic volumes for Residential streets with direct frontage access of allotments.

This limit is commonly referred to as the **Environmental Capacity** of the street, in contrast to the Traffic Capacity, which is a measure of the ability of the street to carry traffic. Depending on geometric design, the Traffic Capacity may be several times the Environmental Capacity.

Restricting the traffic volume in the street to acceptable Environmental Capacity limits requires:-

- **Limitation of the "Catchment"** contributing traffic to the street to an appropriate extent. This is considered in detail in following sections.
- **Exclusion of Through Traffic** to ensure that only traffic actually generated by that catchment uses the street.

In the case of a cul-de-sac, or a small precinct with only one street connection, the exclusion of through traffic is automatically achieved. However, for all areas with more than one street connection, the possibility of through traffic must be carefully examined, and the layout amended if necessary **to positively discourage through traffic**. This aspect is dealt with in detail in Section 3.0.

- **Exclusion of Unplanned Traffic Generators** Town Planning controls need to be utilised to ensure that land uses other than those designed for do not creep into single dwelling areas, e.g. Multi-unit residential, Shopping Centres etc., at least **not** without appropriate modification of the street system being a condition of approval for such use.

Practical application of the Environmental Capacity limit requires the means to calculate the traffic volume which will be generated in the street.

In a Residential street, with through traffic excluded, this will be the product of the **"Catchment"** expressed in "dwellings", and the **Traffic Generation Rate,** expressed in vehicle trips per day per dwelling.

CATCHMENT

For a single cul-de-sac, or a larger area having only a single street connection, the number of dwellings in the catchment may be counted directly as the number of single-dwelling allotments, on the basis that ultimately all lots will be built on. Allowance must be made for any future resubdivision of larger lots, or likely extension of the street system.
However, for "loop streets", or other areas with two or more connections, a judgement must be made as to the likely split of catchment to each connection, based on consideration of the locations of likely traffic attractions, e.g. employment centres, shopping centres, schools etc.
Where all traffic attractions are in the same general direction this is relatively simple, requiring only selection of a "split point" from which both alternative routes offer equal convenience for drivers. This will usually be the point of equal distance, but not necessarily so if there are factors such as intersections or "slow points".

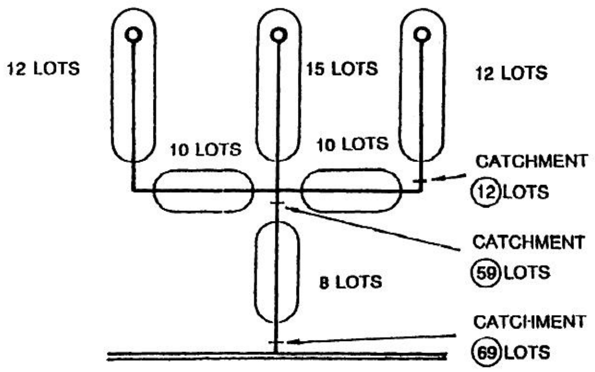
However, where traffic attractions are in different directions, a separate assessment of the catchment generating traffic for each attraction must be made. An example of such a calculation is given in Table 2.2.F.

GENERATION RATE

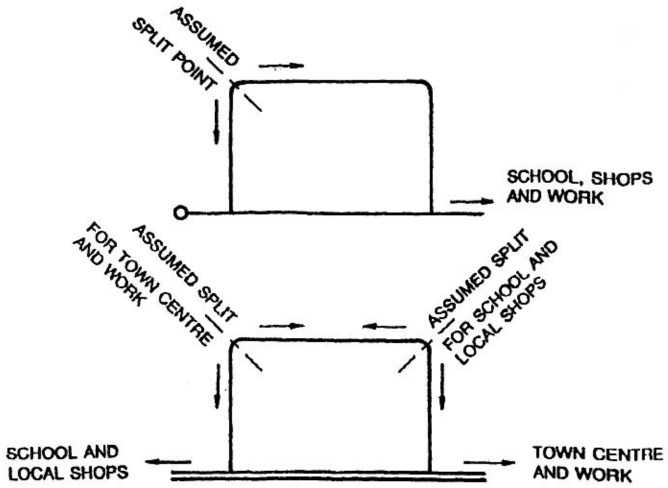
SINGLE DWELLINGS

Traffic generation from residential areas can vary widely, dependent on a number of factors; such as:-

- Size of traffic catchment;
- Geographical location;
- Demography of population - (e.g. young couples, families with adult children, retirees);
- Location of and distance to facilities - (shopping, schools, employment);
- Economic situation of residents - (number of cars per dwelling);
- Availability of public transport;
- Time (as demography of the area changes).



TRAFFIC CATCHMENT FIG. 2.2A



CATCHMENT SPLIT POINTS FIG. 2.2B

FIGURE 2.2.C
SOME RECOMMENDED TRAFFIC VOLUME LIMITS FOR STREETS WITH RESIDENTIAL ACCESS
(Brindle – 1988)

PLACE	MAX TRAFFIC LEVEL	SOURCE
Standards & Guidelines		
U.K. Design Bulletin 32	300 dwellings	DoE (1977)
Cheshire County Council	200 dwellings	Cheshire CC (1976)
Canberra (1980)	4000 veh/d	T. Brimstone (Unpub)
N.S.W.	300 traffic units[a] (2500–3000 veh/d)	Stapleton (1984)
Orange County, California	1200 veh/d	Spitz (1982)
Calgary	5000 veh/d	Bolger et al (1985)
Winnepeg	4000 veh/d	ditto
Toronto	3000 veh/d	ditto
Mississauga	2–3000 veh/d	ditto
Seattle	5000 veh/d	ditto
San Jose	3000 veh/d	ditto
Thousand Oaks	250 dwellings	ditto
Recommendations		
U.S. Research	2000 veh/d	Appleyard (1981b)
Australian Thesis	2500 veh/d	R. Morris (Unpub)
Australian Review	300 dwellings	Comerford (1986)
ditto	2500 veh/d	McKinna (1976)
ditto	3000 veh/d	Holton & Pattinson (1976)
Commonwealth Bureau of Roads	1500 veh/d	(Unpublished)
Nicholas Clark & Assocs	3000 veh/d	Clark (1975)
Alan M. Voorhees & Parts.	2000 veh/d	Voorhees (1978)
Traffic in Towns	2–3000 veh/d	Buchanan (1963)
U.S. Review	1200 veh/d	Spitz (1982)

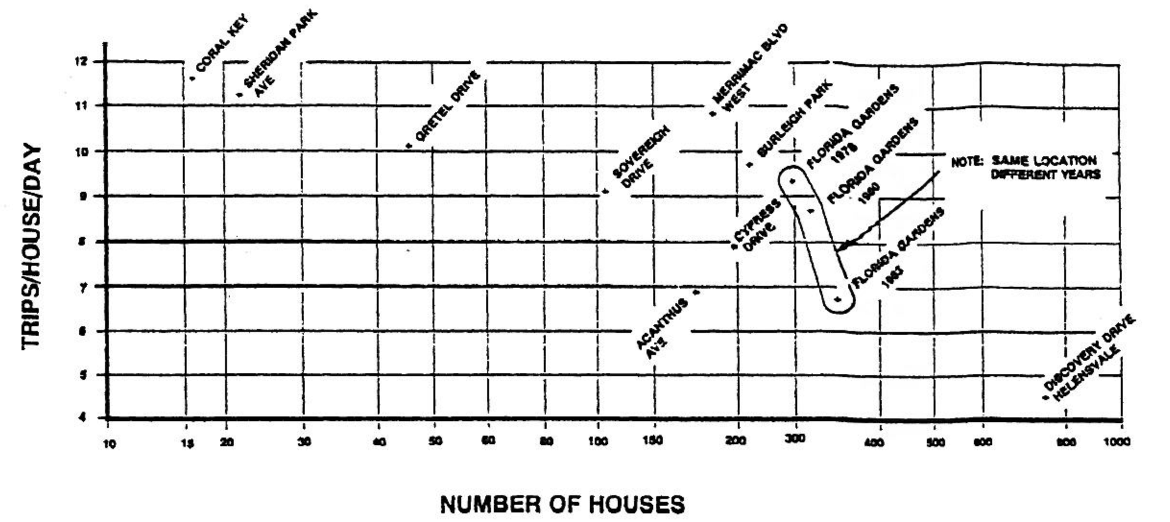


FIGURE 2.2.D Source - Albert Shire Traffic Counts

As an example only, Figure 2.2.D shows the variation of Trip Generation with Traffic Catchment, and over a period of time, for a number of different catchments in a particular area (Southern Albert Shire).

The generally accepted design Generation Rate for catchment sizes applicable for a residential street is **10 trips per dwelling per day**

This figure includes some allowance for a future increase in generation rates.

USES OTHER THAN SINGLE DWELLINGS

While the predominant land use in average residential streets is single detached dwellings, some catchments may contain other dwelling types or land uses.

For traffic generation calculations it is convenient to reduce these uses to "Equivalent Dwellings", using the representative figures given in Table 2.2.E:-

EQUIVALENT DWELLINGS

Separate dwellings or Duplexes	1.0
Flats, Units, Townhouses (Average quality, generally single family)	0.6
Luxury units, or likely multi-family occupancy units	1.0
Retirement villages - per unit	0.4
Local Shops - Per 100 m² of Gross Floor Area	6.0
Primary School	50.0
Small local sporting and similar facilities	10.0

EXAMPLE: Retirement Village of 20 units
"Equivalent Dwellings" = 20 x 0.4 = 8

TABLE 2.2.E

For the great majority of streets, where there is no direction split of traffic (see Section 2.2), the maximum acceptable Environmental Capacity of **2000 to 3000 vehicles per day**, and traffic generation rate of **10 trips per dwelling per day**, combine to give the following standards for the "Maximum Traffic Catchment" for a street with direct residential frontage.

Desirable Maximum - **200** Equivalent Dwellings Catchment

Absolute Maximum - **300** Equivalent Dwellings Catchment

Where traffic attractions are in different directions, a separate assessment of the traffic volume resultant from each attraction must be made, and the individual volumes added to obtain the total volume at any point in the street.

This procedure requires a judgement of the **distribution** of the total traffic generation between the individual traffic attractions.

As discussed previously, the total traffic generation per allotment varies with a number of factors, and the actual distribution of the traffic generated will also vary with these factors, and in particular with:-

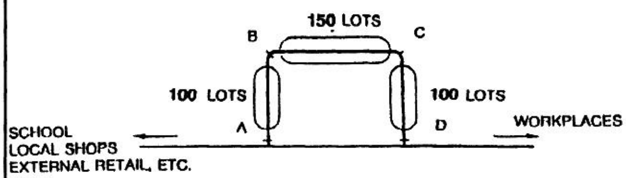
- the extent and location of facilities within the neighbourhood (shop and schools);
- location of employment centres external to the neighbourhood;
- location of major retail centres and other attractions external to the neighbourhood.

In some cases previous traffic studies may provide area-specific data to use as a basis for assessment of traffic generation and distribution, but in default of such data the figures in Table 2.2.F are suggested.

Trips per Dwelling per day

Home to/from locations within the neighbourhood	**Shops**	**2**
	School	**1**
Home to/from locations external to the neighbourhood	**Work**	**4**
	Retail	**2**
	Other	**1**
	TOTAL	**10**

EXAMPLE:



Westward Attractions		**Eastward Attractions**
Neighbourhood School	1	Work - 4 trips/day
Neighbourhood Shops	2	
External Retail	2	
External Other	1	
TOTAL	**6 Trips/day**	**4 Trips/day**

Split Point - C

Node	Catchment		Trips		Volume
B	150	x	6	=	900
A	250	x	6	=	1500
D	100	x	6	=	600

Split Point - B

Node	Catchment		Trips		Volume
C	150	x	4	=	600
D	250	x	4	=	1000
A	100	x	4	=	400

Total Volumes (v.p.d.)

A	1500	+	400	=	1900
B	900	+	-	=	900
C	-	+	600	=	600
D	600	+	1000	=	1600

TABLE 2.2.F

TRAFFIC VOLUME

OBJECTIVE

* To provide acceptable levels of access, safety and convenience for all street users in residential areas, while ensuring acceptable levels of amenity, and protection from the impact of traffic ***(AMCORD O1, page 46);***

* To avoid streets within any residential neighbourhood from operating as through traffic routes for externally generated traffic ***(AMCORD O10, page 46);***

PERFORMANCE CRITERIA

* The design features of each type of residential street to convey its primary function and encourage appropriate driver behaviour ***(AMCORD P4, page 48);***

* Within any network in a residential development, the component streets conform to the adopted functions set out in Tables B6.1 and B7.1 ***(AMCORD P1, page 46)***

* Street layout which provides that no dwelling fronts a street which carries an unacceptable volume of traffic.

* Street layout which provides that a maximum percentage of dwellings front streets which carry a minimum volume of traffic.

ACCEPTABLE SOLUTIONS

* Street layout which provides that no dwelling fronts a street with a Traffic Catchment exceeding 300 Equivalent Dwellings, or a Traffic Volume exceeding 3000 vehicles per day.

* Street layout which provides that the majority of dwellings front a street with a Traffic Catchment of less than 200 Equivalent Dwellings.

* Street layout which positively excludes through traffic.

* Traffic volumes to be calculated in accordance with Tables 2.2.E and 2.2.F.

* Conformity with Deemed-to-Comply Criteria of Section 3.0, Street System.

DEFINITIONS

SPOT SPEED

The Spot Speed is defined as the 85 percentile maximum operating speed (i.e. the maximum speed not exceeded by 85% of vehicles) at a **particular** point within the street.

STREET SPEED

The Street Speed is defined as the 85 percentile maximum operating speed attained at **any** point within the street.

DESIGN SPEED

The Design Speed is defined as the Street Speed selected as being appropriate for the subject street.

EFFECT AND CONTROL OF TRAFFIC SPEED

Higher traffic speeds in Residential streets are detrimental to:-

Safety	Increased risk and severity of accident
Amenity	Reduced residential amenity from noise
Convenience	Greater gaps necessary to enter traffic or cross streets.

Of these the most significant effect of traffic speed is the potential risk to the **Safety** of pedestrians and cyclists.

Studies suggest the following degree of injury severity likely for pedestrians and cyclists involved in an accident with a car:-

24 km/h or less	-	Slight injury
24-39 km/h	-	Moderate
40-52 km/h	-	Serious
52 km/h +	-	Fatalities start to occur

(Oei, 1988)

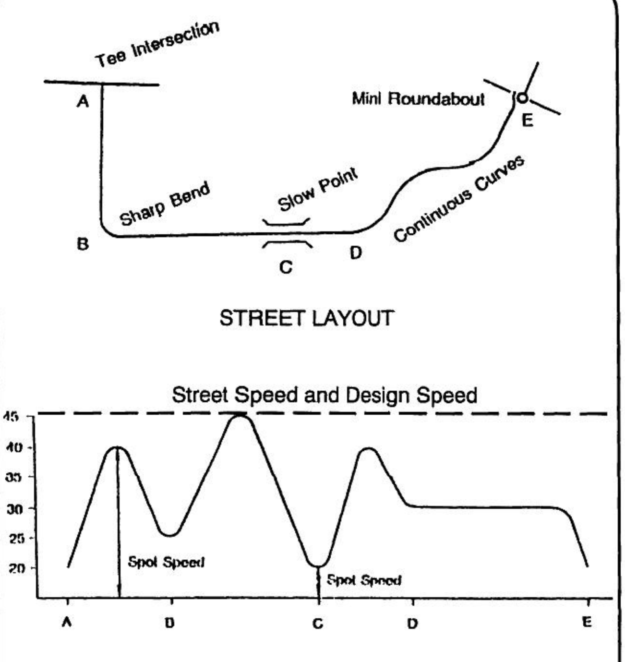
Traditionally, traffic speed has been regulated by legislation and police enforcement. However, within residential streets effective police enforcement is quite impracticable.
Therefore, speed regulation should be **built in** to the street geometry, to create an environment where drivers are actively discouraged from driving at more than a very moderate speed.

This can be done by inducing in drivers a feeling of constriction. A wide, straight road with long sight distance fairly invites a higher speed, while in constrained conditions, such as on a narrow winding bush track, with trees close on either side, or in a narrow urban laneway with tall buildings and parked trucks both sides, a slower speed is instinctive.

SPEED PROFILE

Typical vehicle speed along a street will vary with the street geometry, slow at entry intersection, accelerating to a maximum, then decelerating to the end of the street, intersection, or tight radius bend.
Only on a long straight, or through a long curve or series of curves, will the maximum speed be sustained.

Figure 2.3.A shows diagrammatically the relationship of the speed profile to street geometry.



SPEED PROFILE
Fig. 2.3.A.

CARRIAGEWAY WIDTH AND VERTICAL ALIGNMENT

On long straight sections of street the speed of traffic is controlled only by the width of the carriageway.
On a single-lane carriageway the Street Speed may

be expected to be limited to 25 to 30 km/h, due to the constriction of carriageway width, and likelihood of having to slow or stop for opposing traffic.

However on wider carriageways actual speeds will vary considerably with traffic volume and the incidence of parked vehicles on the carriageway.

It is therefore considered that, while street carriageway widths should be the minimum necessary for satisfactory traffic operation (see Section 2.6), **carriageway width in itself should not be relied on to restrict traffic speed, but considered as one factor in creating a low-speed environment.**

The actual extent of sight distance available as a result of the **vertical alignment** of a street is not readily judged by drivers. Hence, while a restrictive vertical alignment can also be a factor in creating a low-speed environment, it too should not be relied on to limit traffic speed.

SPEED RESTRICTIVE DESIGN

Limiting speed by means of street design geometry is therefore essentially a matter of **restricting the maximum length of uncontrolled straight (or virtually straight) street to the length in which the selected Design Speed may be reached.**
This may be attained by:-

- **Limiting Total Street Length**-in the case of short cul-de-sac or connecting streets;
- **Limiting Length of Straight**-by introducing sharp bends in the street layout;
- **Curved Alignment**-either a single curve or a series of curves;
- **Control Devices**-in an otherwise straight alignment.

STREET LENGTH

For straight (or virtually straight) street alignment, with end conditions which reduce vehicle speed to 20km/h or less, a relationship between Street Leg Length and Street Speed is given in Table 2.3.B.

BENDS OR CURVES

Where speed restriction is provided by bends or curves in the street alignment the relationship between the Radius of the bend and the Street Speed is given in Table 2.3.C.

However, it should be noted that bends or curves are only effective for speed restriction if the deflection angle is relatively large - perhaps 60 degrees or more.

COMBINATION ALIGNMENT

Where a bend, or other form of speed restricting device, can be negotiated at a speed higher than 20 km/h, the length of following straight within which a vehicle can attain the Design Speed will be less than that given in Table 2.3.B.

Table 2.3.D gives the relationship between the Negotiation Speed of the bend or slow point, and the maximum length of following straight between restrictions, to limit traffic to a particular Design Speed.

SELECTING A DESIGN SPEED

It must be noted that the "Design Speed" used in this Code is the 85 percentile **Maximum** speed of traffic within the street, and hence is quite different to the Highway design concept, where the Design Speed is the **Minimum** safe speed at any point on the road.

From consideration of pedestrian and cyclist safety, the ideal is the lowest possible Design Speed. However, this ideal must be evaluated in the context of **practical limitations** and **driver convenience.**

PRACTICAL LIMITATIONS

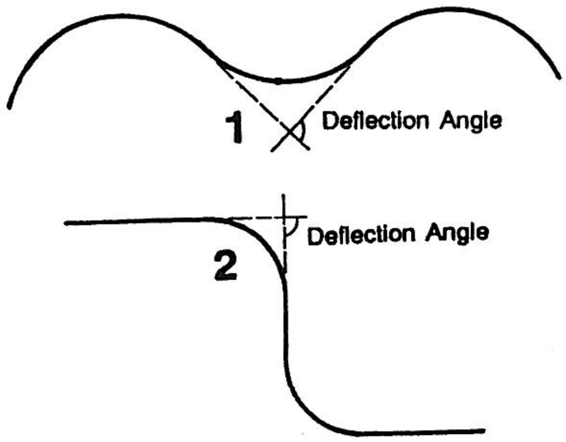
From Table 2.3.B, a Street Length of 40m is applicable to a Design Speed of 25 km/h, and 75m to a Design Speed of 30 km/h.

In all but the shortest cul-de-sac, a Street Length of 75m is considered to be the least practically attainable, and **30 km/h** is therefore proposed as the Design Speed to be sought for the majority of residential streets.

DRIVER CONVENIENCE

There is a reasonable limit to the time for which drivers may be expected to tolerate the low-speed conditions sought to be attained in residential streets. This time is generally considered to be between 60 seconds and 90 seconds. This limitation may require acceptance of rather higher Design Speeds on the residential streets serving larger traffic catchments. However, **40 km/h** is considered to be the **highest** Design Speed desirable for residential streets with direct frontage access, from consideration of residential amenity, and pedestrian and cyclist safety.

BENDS OR CURVES
TABLE 2.3.C



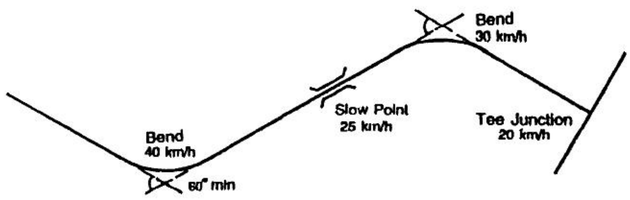
Notes: *Radii on carriageway centre line
*May not be effective with deflection angles less than (say) 60 degrees

Desired Max'm Vehicle Speed (km/h)	Curve Radii: Continuous Series of Bends(1) (metres)	Curve Radii: Isolated Bends or in a Chicane(2) (metres)
20	15	10
25	20	15
30	30	20
35	50	30
40	90	40
45	105	50
50	120	60
55	140	70
60	160	80

(1) Based on field surveys (Stapleton, 1988)
(2) E+F = 0.35

(AMCORD D15, page 54)

COMBINATION ALIGNMENT
TABLE 2.3.D



NEGOTIATION SPEED OF BEND ETC., (Km/h)	LENGTH OF STRAIGHT(m) BETWEEN RESTRICTIONS TO LIMIT DESIGN SPEED TO (Km/h).						
	25	**30**	**35**	**40**	**45**	**50**	**60**
20 or less	40	75	100	120	140	155	180
25	-	45	75	100	120	140	165
30	-	-	45	80	100	120	150
35	-	-	-	50	80	100	135
40	-	-	-	-	55	80	120
45	-	-	-	-	-	60	105

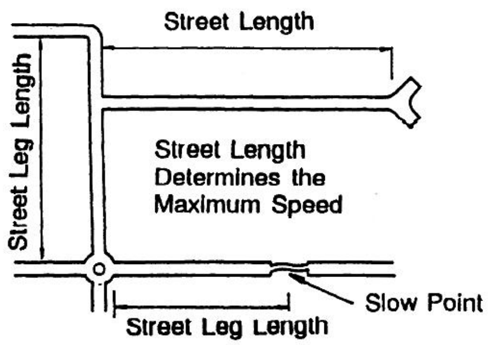
(Amcord - D17, page 56 - modified)

EXAMPLE:- What is maximum allowable straight between bends of 30m radius, to maintain Design Speed of 50km/h ?
From Table 2.3.C, negotiation speed of 30m radius bends is 35km/h.
From Table 2.3.D, for negotiation speed of 35 km/h maximum length of straight for Design Speed of 50 km/h is **100m.**

NOTE:- Where adjacent speed restricting devices have different Negotiation Speeds use the Mean of the two Negotiation Speeds.

Note:
Street lengths and curve radii in Tables 2.3.B, C and D are indicative only and subject to on-going evaluation.

DESIGN SPEED (km/h)	STREET LEG LENGTH (m)
25	40
30	75
35	100
40	120
45	140
50	155
60	180



STREET LENGTH
FIGURE 2.3.B

Notes:
End Condition - 20 km/h or less
For grades of 5 to 10% - Add 5 km/h
For grades of over 10% - Add 10 km/h
(AMCORD - D13, D14, page 54, modified)

"End Conditions" reducing vehicle speed to 20 km/h may include :-

* T- intersections with radii conforming to Section 2.11.
* Roundabouts conforming with Section 2.11.
* Bends (approximately 90 degrees) of radius 9m or less.
* Traffic Control Devices (e.g. Speed Humps or Slow Points) of appropriate design.

NOTE:
The above speeds and lengths should not be regarded as absolutes. Variations of 10-15%, whilst not accepted as the norm, may be acceptable in some circumstances.

TRAFFIC SPEED

OBJECTIVES

- ***To provide a street environment which allows all users - motorists, pedestrians and cyclists, - to proceed safely and without unreasonable delays.***
(AMCORD O2, page 60)

PERFORMANCE CRITERIA

The design features of each type of residential street to convey its primary function and encourage appropriate driver behaviour.
(AMCORD P4, page 62)

Design of the carriageway to discourage motorists from travelling above the intended speed by reflecting the functions of the street in the network: in particular, the width and horizontal and vertical alignment not to be conducive to excessive speeds.
(AMCORD P5, page 62)

Street geometry design which effectively restricts vehicular speeds to appropriate limits.

ACCEPTABLE SOLUTIONS

Selection of an appropriate Design Speed for each street, in accordance with Section 2.10

Where the street length is limited in order to control the vehicle speed, the lengths specified in Table 2.3.B shall be used.

Where bends are introduced, the radius of the bend in relation to the maximum speed shall be as set out in table 2.3.C

ON-STREET v ON-SITE PARKING

Vehicle parking within the street is an unwelcome necessity:-

Unwelcome in that:-

- Vehicles take up space on the carriageway, an inefficient use of a relatively expensive facility,
- Vehicles parked on the carriageway impede drivers' visibility of children or other vehicles,
- Parked vehicles are a visual intrusion in a residential area.

Necessary in that provision must be made for:-

- Overspill of some residential vehicles
- Visitors' vehicles
- Service and delivery vehicles.

Hence ideally as much parking as possible should be provided **within the allotments,** with only a reasonable minimum being provided within the street.

TOTAL PARKING REQUIREMENT

In "traditionally" designed subdivisions there is generally ample availability of parking space on the street, indeed an oversupply, due to the wider carriageways and larger allotment areas. However, narrower carriageways, smaller lots and reduced or zero front set-back, all reduce parking opportunity, and make it necessary to ensure that adequate parking provision is available both within the allotments and within the street.

Total parking demand will reflect vehicle ownership, and will vary greatly, dependent on such factors as:-

- Socio-economic situation of the area generally and of each household
- Demography of each household (which will vary with time)
- Location of the area, in relation to facilities and employment
- Availability of public transport.

The 1986 Census figures indicate Australia-wide figures for "Vehicles parked per Dwelling" of:-

	Average	1 or Less	2 or Less	3 or Less
Separate/Semi-Detached Housing	1.6	50.3%	86.4%	95.6%
Medium Density/ Row/Terrace	0.9	82.8%	97.8%	97.8%

Hence it is considered that a reasonable provision for **total parking,** with an allowance for occasional "peaks" and some future increase in vehicles ownership would be:-

Separate Dwellings - and Duplexes	**2.5 vehicles/dwelling (Providing for 91.0 percentile demand.)**
Medium Density -	**1.5 vehicles/unit (Providing for 90.3 percentile demand.)**

PARKING WITHIN ALLOTMENTS

Factors which affect the availability and use of parking within the allotment include:-

- **Allotment area and shape**
  smaller lots and frontage reduce parking opportunity.
- **Slope of allotment**
  steep slope reduces parking opportunity.
- **Location of dwelling and other improvements**
  affects number and convenience of use of parking spaces. Reduced set-back reduces parking opportunity.
- **Future construction**
  e.g.swimming pools, conversion of garage to rumpus room, may reduce the original parking opportunities.
- **Width of street carriageway, traffic volume, and security of the area**
  perceived risk to vehicle encourages parking within allotment.

However, the major factor is whether, and if so what, control the Local Authority exercises over on-site parking provisions.

ALLOWANCE FOR STREET PARKING

DESIGN PARKING PROVISION

Provided that the Local Authority requires that a **minimum of two (2.0) car spaces** be maintained within each allotment, (in the initial building approval and by control of later building works) it is considered that for Separate Dwellings and Duplexes a reasonable design provision for street parking is **0.5 car spaces per lot** (i.e. one space per two allotments).

If no effective control is exercised, the on-street design provision should be increased to **0.75 spaces per lot.**

The **Average** demand for on-street parking in most areas is about **0.25 spaces per lot.**

In the case of Multi-unit development most Local Authorities require an on-site parking provision of 1.5 to 2.0 car spaces per unit. However, the likelihood of some overspill into the street, particularly of visitor parking, must be assessed for such development.

Street parking must be located conveniently if it is to be used by residents. Hence, each lot should have a car parking space within a **maximum of 25m.** (measured between the nearest points of the lot boundary and the parking space), and desirably a double-length space for use by the occasional delivery vehicle should be available within 40m of each lot.

PEAK PARKING DEMANDS

On occasions there will be a parking demand in excess of available on-street parking, such as for a party, garage sale or auction.

It is not reasonable to design for such infrequent occasions, and at these times parking must be expected to overspill onto the grassed verge or into adjacent streets.

EXTERNAL PARKING GENERATORS

In some cases, the subdivision layout may be such that external non-residential uses generate a parking demand within adjacent residential streets due to convenient pedestrian pathway connections - e.g. school, kindergarten, shops, railway, bus-stop, park or sporting facilities.
It is necessary to ensure that adequate parking is provided for such uses to avoid parking overspill into the adjacent streets.

NON-RESIDENTIAL VEHICLES

The parking of a large commercial vehicle, such as a truck or bus, in front of the driver's residence is a common cause of neighbours' complaints, and would be even less tolerable in a narrow carriageway street.

However, it is probable that reduced parking availability would discourage parking of oversize vehicles, and encourage drivers to make alternative arrangements.

ALTERNATIVES FOR STREET PARKING

Parking provision within the street may be in various forms:-

On-Carriageway Parallel - The "traditional" method, where the carriageway is of sufficient width to provide one or more moving lanes, and for parking on one or both sides.

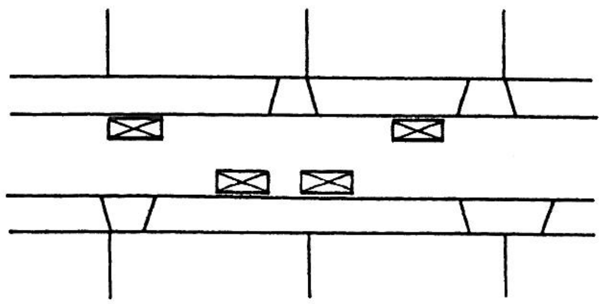


Fig. 2.4.A

Parking facility is continuous for the full street length, and the pavement construction is of constant type.

For	-	Simple design and construction
Against	-	Carriageway area may be greater than necessary
	-	Visually wide carriageway encourages higher speed.

Indented Parallel Parking Bays - A carriageway providing two moving lanes, or one moving lane with passing areas, may be supplemented by indented parking bays for parallel parking, on one or both sides of the carriageway.

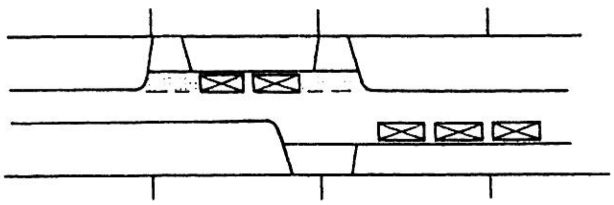


Fig. 2.4.B

Only sufficient length of parking bay to cater for demand need be provided. Desirably the bays should be in a different surfacing to the moving lane(s).

For - Minimum area of carriageway required
- Visually narrow carriageway discourages higher speeds.
- May be efficiently combined with driveways.

Against - Relatively complicated design and construction

Indented 90° Parking Bays - Again a carriageway for one or two moving lanes may be supplemented by parking bays at 90° to the carriageway, on one or both sides.

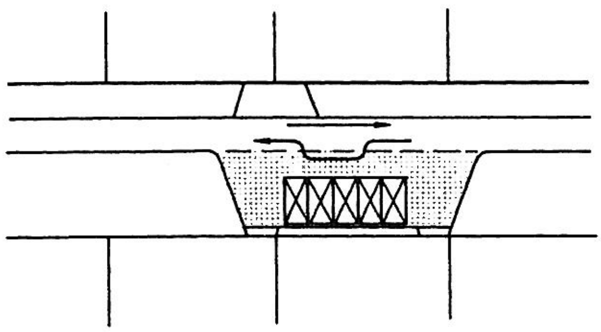


Fig. 2.4.C

In the case of a single moving lane carriageway, the necessary width for vehicles to turn into the parking bays may provide also for opposing vehicles to pass.

This parking configuration is considered suitable only for lower design speed streets, to 40 km/h maximum.

For - Provides also for vehicle passing opportunity
- Minimum visual carriageway width

Against - Concentrates parking activity (noise, headlights) in front of a few lots.
- Requires greater localised reserve width (but varied width may be an advantage).

Special Parking - Parking bays may be provided in areas such as in the centre of cul-de-sac turning circles, combined with "hammerhead" or "Y" turning areas, or within wide medians.

They are particularly appropriate at the end of cul-de-sac streets, where narrow allotment frontages may reduce both on and off-street parking opportunity. (See Section 2.12).

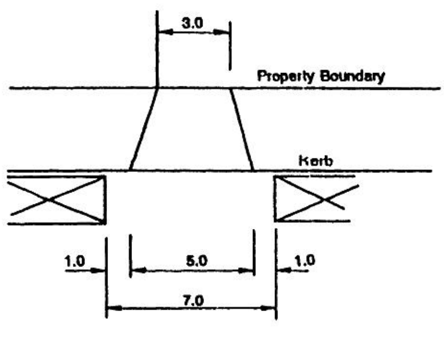
PARALLEL PARKING REQUIREMENT

For parallel parking, either on-carriageway or in indented bays, the total length required will be dependent on:-

- Design rate of parking demand (Spaces per lot)
- Average allotment frontage
- Driveway requirements

DRIVEWAYS

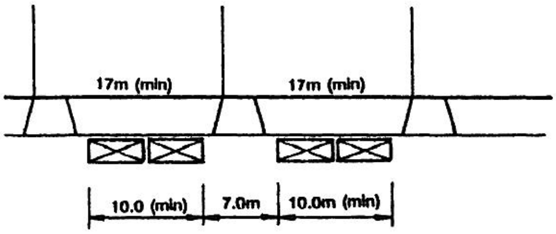
On narrower street carriageways such as proposed, the typical driveway geometry required is:-



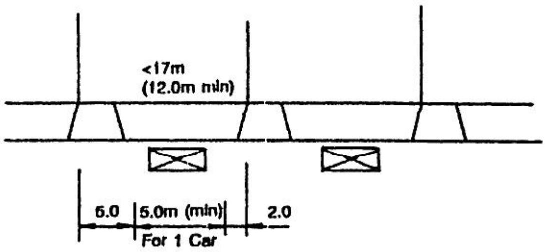
Each driveway therefore requires 7.0m of lane length.

PARKING SPACES PER FRONTAGE

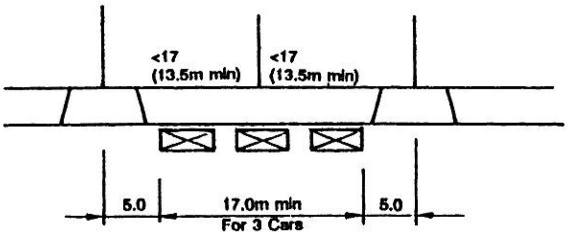
For average lot frontages of **17m or over**, the possible parallel parking capacity is **two spaces per lot.**



For average frontages of **less than 17m**, the parking capacity is variable with driveway location, e.g.



A. Driveways Same Side.
Capacity 1.0 Space per Lot



B. Driveways "Paired"
Capacity 1.5 Spaces per lot

If driveway locations are **designed** in pairs, as in **B** above, the higher capacity of **1.5 spaces per lot** is available with the added bonus that the double driveway length is sufficient for a **"passing bay".**

However, if driveway locations are not designed but are **random** depending on the individual house design, the average parking capacity will be somewhere between the two values, say **1.25 spaces per lot.**

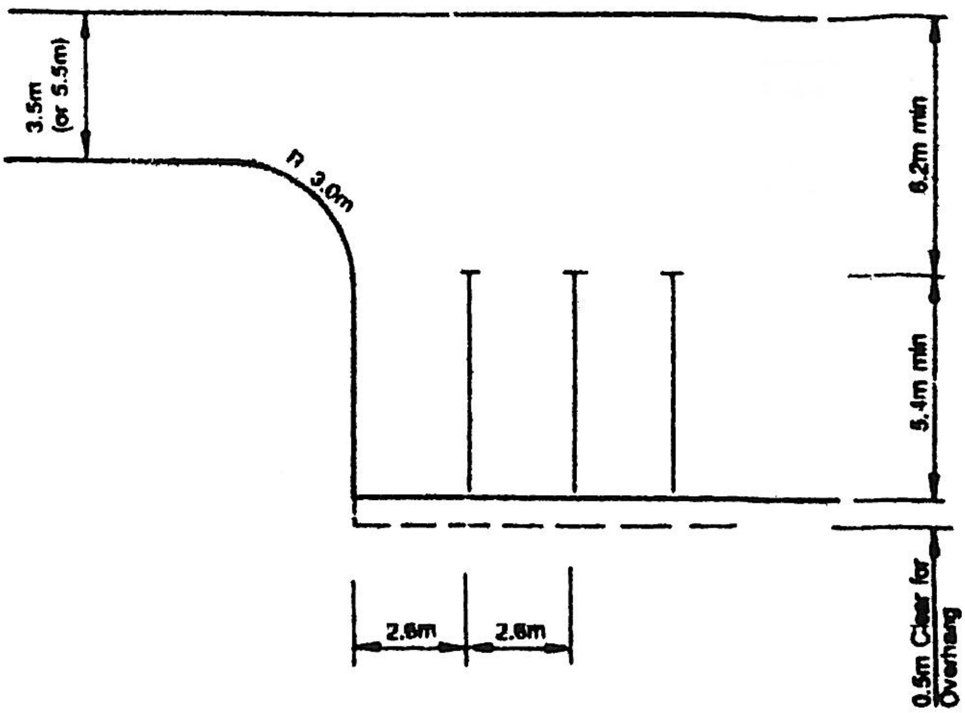
Where frontages of less than 12.0 m are proposed, special design of parking and vehicular access is necessary.

PARKING CAPACITY

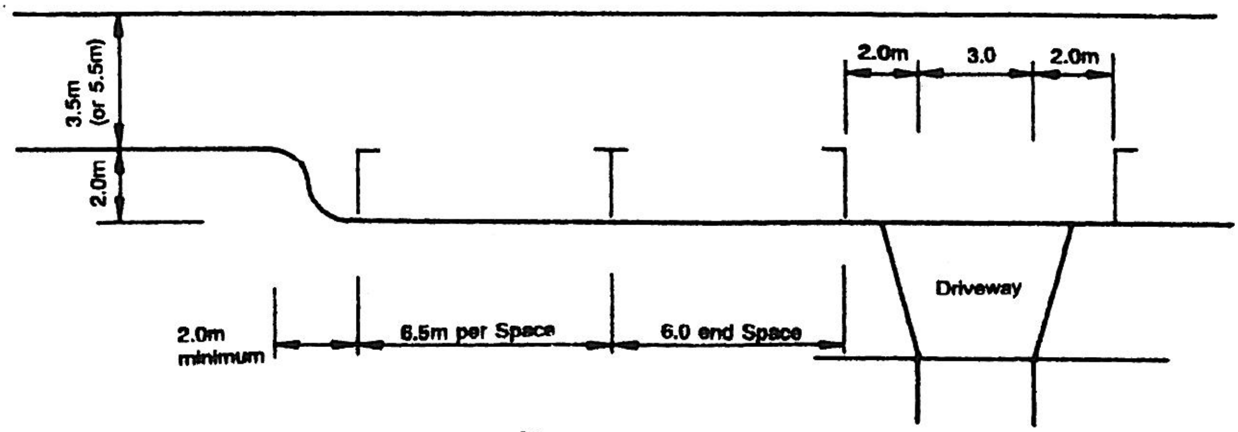
The resultant theoretical parallel parking capacity of a street, allowing for a single unobstructed moving lane, will therefore be:-

	Parking Spaces per Lot	
Average lot frontage	**Two lane street**	**Three lane street**
17.0 or more	1.0	2.0
Less than 17.0m (12.0 m min) (Random driveways)	0.62	1.25
Less than 17.0m (13.5 m min) (Paired driveways)	0.75	1.50

These are not necessarily practical parking capacities, due to possible lack of adequate passing opportunity for opposing vehicles. However, the significance is that small frontage lots on narrower carriageways require special design of parking (and/or passing) provision.



90 Degree Parking



Parallel Parking

Fig. 2.4.G - TYPICAL STREET PARKING DETAILS

PARKING

OBJECTIVES

- ***To provide sufficient and convenient parking for residents, visitors and service vehicles.*** ***(AMCORD, O1 page 34)***
- ***To ensure that parked vehicles do not obstruct the passage of vehicles on the carriageway or create traffic hazards.*** ***(AMCORD, O2, page 34)***

PERFORMANCE CRITERIA

- Provide resident and visitor carparking according to projected needs, taking into account:-
  -Total parking demand.
  -Parking opportunities within allotments.
  -Non-residential and external parking generators. ***(AMCORD, P1 page 34, Modified)***
- Parking provision shall be designed to ensure:
  -No obstruction or danger to the passage of vehicles on the carriageway, or to pedestrians.
  -Efficient design of parking spaces and accesses.
  -Convenient vehicle access to allotments.

ACCEPTABLE SOLUTIONS

- Construction within the street reserve of areas sufficient to provide the following minimum level of parking:-
  a) Separate Dwellings and Duplexes, where the Local Authority maintains control of the minimum level of parking within allotments-
  - 0.5 spaces per lot
  b) Separate Dwellings and Duplexes, where no such control is maintained -
  - 0.75 spaces per lot
- One car space to be available within 25m of each allotment (measured between the closest points). ***(AMCORD O5, page 36, modified)***
- Car spaces may either be provided on the carriageway, in which case provision shall be ensured for vehicle passing in accordance with Section 2.5, or in constructed bays within the verge.
- The dimensions of all parking spaces and access thereto shall be in accordance with AS2890.1 (1986) and with Figure 2.4.G. ***(AMCORD D4, page 36, modified)***

PROVISION FOR PASSING 2.5

CONCEPT

The concept of a "Single-Moving Lane" obviously relies for its successful operation on the availability of adequate opportunities for vehicles travelling in opposite directions to pass each other.

TYPES OF PASSING PLACES

Provision for opposing vehicles to pass may be:-

DESIGNED

Either solely for passing purposes or serving a dual purpose, for example:-

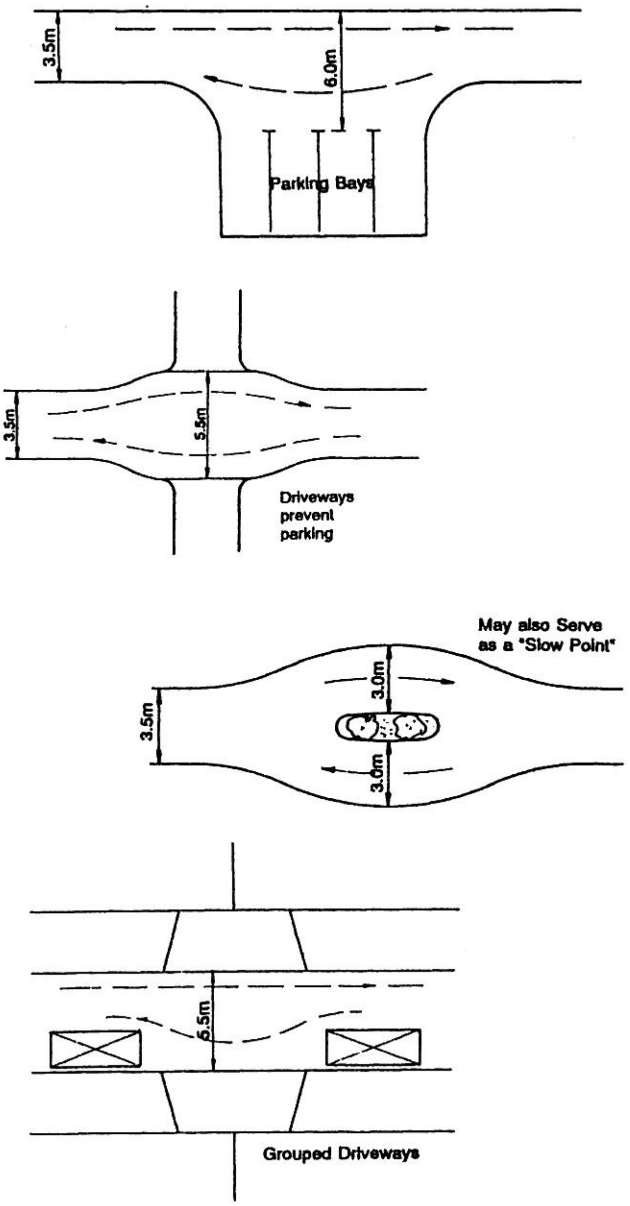


Fig. 2.5.A

RANDOM

A carriageway width in excess of a single lane provides for both parking and passing of vehicles.

The extent to which this extra width exceeds parking demand creates passing opportunities at random intervals, which will vary both from place to place and from time to time.

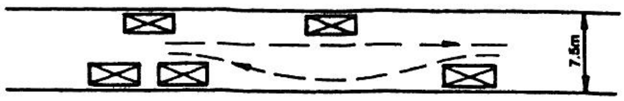


Fig. 2.5.B

COMBINATION

Designed and Random passing opportunities may be combined in the same street.

DEMAND FOR PASSING OPPORTUNITY

The demand for passing opportunities is a function of the number of vehicles travelling in the opposite direction which a driver will encounter in a trip between home and the major road system.

This **"Incidence of Opposing Meetings"** varies with:-

- **Traffic Volume** of opposing traffic, which in turn will vary with:-
  - Number of lots in the traffic catchment;
  - Time of day (Peak or off-peak traffic).
- **Travel Time** which will vary with the travel distance and travel speed.

The **Worst Case** will be a trip between the extreme end of the street system and the major road system, "against the tide" of the peak hour traffic; while the **Average Case** is a trip from the mid-point of the street system, in an average hour.

Figure 2.5.C gives an indication of the number of meetings with opposing vehicles which could be expected to occur under various circumstances, for a typical residential subdivision layout.

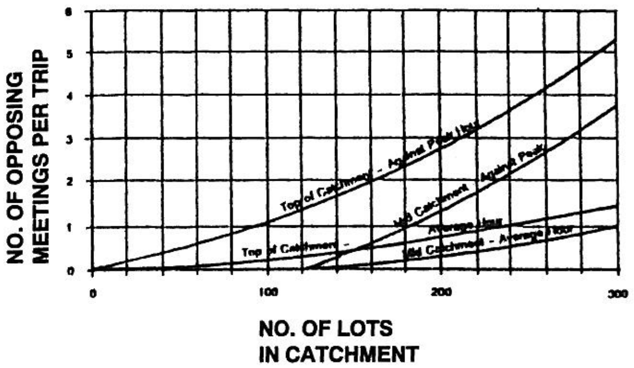


Fig. 2.5.C

SUPPLY OF PASSING OPPORTUNITY

Since the number of meetings with opposing vehicles increases with the number of lots in the "traffic catchment", the supply of passing opportunity should also increase with the number of lots, from a minimum at the head of the catchment (i.e. nominally zero at the end of each cul-de-sac street) to a maximum at the connection(s) to the major road system. An **Under-supply** of opportunity will result in increasing delays to traffic, and in the extreme to virtual blockage of traffic trying to travel "against the tide". On the other hand an **Over-supply** is wasteful of carriageway area, and undesirable for the reasons listed in Section 2.1.

SINGLE LANE CARRIAGEWAY

For a single lane carriageway the **only** passing opportunity is provided by **designed** passing places at appropriate intervals.

Generally the spacing will be within the range of 30m to 80m, a lesser spacing being uneconomical and a greater spacing making it difficult for drivers to judge the location of an opposing vehicle. Passing places must also be intervisible.

Passing places must be designed to minimise the risk of their being made ineffective by incorrect parking (see Figure 2.5.A for examples).

For opposing meetings in this situation, in most cases one vehicle will be in transit between passing places and hence will suffer **no delay** while the other must wait until the first clears the single lane section, and hence will suffer a delay dependent on the distance between passing places. Figure 2.5.D indicates appropriate spacing based on the number of lots in the traffic catchment, and hence the volume of opposing traffic.

TWO LANE CARRIAGEWAY

Small Lot Frontages

As noted in Section 2.4 the situation of a Two-Lane Carriageway with small lot frontages (i.e. less than 17.0m average) and high parking demand carries the risk that only a slight excess of parking demand could result in loss of passing opportunity and hence virtual blockage of traffic movement.

In such cases there are two possible approaches:-

- **Designed Passing Places** to be provided as for Single Lane Carriageways, at maximum spacing in accordance with Figure 2.5.D.
- **Additional Parking Spaces** to be provided clear of the two lane carriageway, to increase the availability of random passing opportunity. The required additional parking to provide passing opportunity approximately equivalent to 17m allotment frontages is shown in Table 2.5.E.These spaces may be provided either by widening the carriageway locally to three lanes or in 90 degree indented bays.

Larger Lot Frontages

Again with reference to Section 2.4, where the average allotment frontage is 17m or more the percentage of street length required for parking reduces substantially, and hence passing opportunity increases.

In this situation the intervals between parked vehicles provide acceptable random passing opportunities.

For most opposing meetings at higher parking demands, the situation will be similar to a Single Lane carriageway, i.e. one vehicle will suffer little or no delay, while the other must wait for the first to clear the section obstructed by parked vehicles. However, in general the "single lane length" will be considerably shorter than on a Single Lane carriageway.

THREE LANE CARRIAGEWAY

A three lane carriageway provides for two moving lanes and one parking lane, or two parking lanes and one moving lane. Hence free passing of opposing vehicles is obstructed only when parked vehicles are located opposite each other or close enough to prevent both moving behicles from weaving their courses between them.

Even with a higher level of parking (0.75 vehicles per lot) two free lanes will be available over much of the street length, and delay will only occur when two opposing vehicles meet at, or in close proximity to, vehicles parked opposite each other.

The **majority** of passing movements will occur without any delay other than perhaps a momentary slowing.

DELAYS

Assessment of the actual delay which might result in each of the above situations involves a number of assumptions. For a Single Lane carriageway the results are reasonably calculable, but in the other cases can be indicative only. However, typical average delays might be:-

Single Lane 80m between passing places **5.0 secs**
30m between passing places **3.2 secs**

Two Lane - **3.0 secs**

Three Lane - **0.75 secs**

ACCEPTABLE LIMIT OF DELAY

The limit of the application of the "Single Moving Lane" concept is the extent to which delays due to meeting opposing vehicles can be kept to a level acceptable to the majority of drivers.

A logical basis for the design of Passing Provision is considered to be limitation of the:-

Maximum percentage increase in travel time in any street length resultant from meeting delays.

While selection of an appropriate allowable percentage increase is very subjective, it is suggested that **10%** may be a reasonable, if conservative, figure, this being calculated on the **maximum** opposing traffic volume. The **average** percentage increase in travel time, over all situations, will then be only approximately 2.5-3%.

On this basis, the maximum acceptable number of lots in the traffic catchment for each street cross-section can be calculated as:-

Single Lane- **46 to 72 lots**
Two Lane - **75 lots**
Three Lane - **303 lots**

The figure for a Three Lane carriageway confirms the assumption that the "Single Moving Lane" concept is applicable to all streets having frontage of residential lots (i.e. maximum traffic catchment 300 lots).

The Design Charts Figures 2.5.D and 2.6.G are derived on the bases of the above figures.

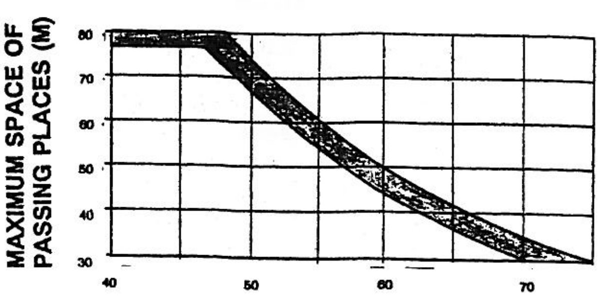
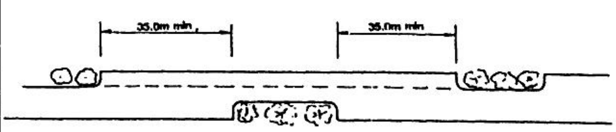


Fig 2.5.D

Allotment Frontages	Additional Parking Spaces per lot
17	0.00
15	0.10
13	0.20
12	0.25
10*	0.30

* Special design required.
See Section 2.4
Table 2.5.E



Minimum length 3 lane Section
Fig 2.5.F

PASSING

OBJECTIVES

To provide sufficient and convenient provision for vehicles to pass vehicles travelling in the opposite direction.

PERFORMANCE CRITERIA

Passing provision to be such that delays resulting from meeting opposing traffic are kept to a level acceptable to the majority of drivers.

ACCEPTABLE SOLUTIONS

- Passing provision such that the increase in travel time in any street length resultant from meeting delays is a maximum of 10%.

- **For a Single Lane Carriageway**
  *Number of allotments in traffic catchment
  - 75 maximum
  *Passing places to be **specifically designed** for sole or dual use. (See Sec. 2.6)
  *Minimum length of each passing place
  - 10.0m.
  *Maximum spacing of passing places (length of constriction) in accordance with Figure 2.5.D

- **Two-Lane Carriageway**
  *Number of allotments in traffic catchment
  - 75 maximum
  *Total lane lengths to be provided in accordance with Figure 2.6.G.
  *Additionally, where lot frontages are less than 17m, either:-
  - designed passing spaces to be provided as for a single lane carriage way, or
  - Additional parking spaces to be provided in accordance with Table 2.5.E

- **Three-Lane Carriageway**
  *Number of allotments in traffic catchment -
  - 300 maximum
  *Total lane lengths to be provided in accordance with Figure 2.6.G.
  *Minimum of two lanes to be provided at any point, unless a "Slow Point" is deliberately designed.
  *Where three lanes are provided, the minimum length of three lane section to be 35m. (illustrated in Fig 2.5.F)

GENERAL

The width of the carriageway required for a Residential Street is a function of:-

- Design traffic volume
- Design traffic speed
- Parking provision - on or off carriageway

While the carriageway width must be sufficient to adequately cater for these traffic needs, **excessive** width can be detrimental from considerations of:-

Safety	Wider carriageways encourage higher speeds (see Section 2.3)
Amenity	Visual amenity is reduced. Stormwater runoff and heat reflection are increased
Convenience	Pedestrians have greater crossing distance
	Greater allotment access problems on side slopes
Economy	Greater capital and maintenance costs
	Greater street reserve width required.

CARRIAGEWAY LANES CONCEPT

The total required carriageway width, in terms of the number of lanes, can be shown diagramatically as:-

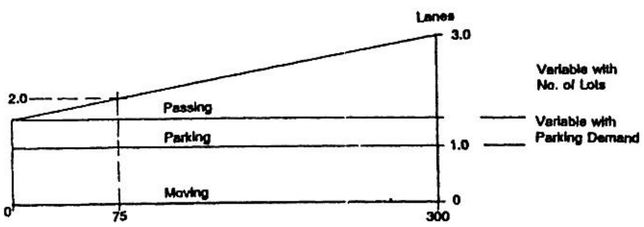


Fig. 2.6.A

This figure combines the conclusions derived in previous Sections, viz:-

- A single **Moving** lane is required for the full street length;
- On-carriageway **Parking** requires an amount of lane length which is variable with Parking Demand but for a given Demand is constant throughout the street length.
- **Passing** requirement increases with traffic catchment throughout the street length.

Figure 2.6.G presents this information in a form whereby the **Carriageway Width** required for a given **Traffic Catchment** may be ascertained.

However its interpretation requires some explanation. The "Required Total Lanes" is the **Average Number of Lanes** required for the **Street Length** under consideration based on the traffic catchment at the "downstream" end of that street length.

At any particular **point** in that street length the carriageway must be an exact number of lane widths, i.e. one, two or three.

Some examples are as follows:-

CATCHMENT LESS THAN 75 LOTS

In this range the designer has two options:

Single-Lane Carriageway

With parking provided off-carriageway (e.g. in 90° indented bays), and passing places provided at spacings decreasing as the traffic catchment increases (see Figure 2.5.D).

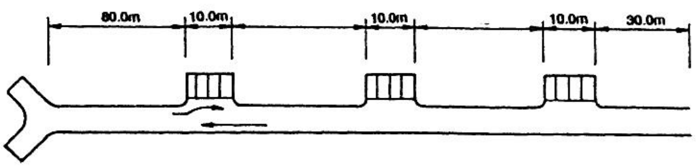


Fig. 2.6.B

Two-Lane Carriageway

In this case the parking demand is very significant. For higher parking demand the full two lanes must be provided for the full length, for all practical purposes, and for the worst case (frontages less than 17m) either passing places must be **designed,** most simply by arranging driveways in groups of four (see also Figure 2.5.A), or additional parking spaces provided, clear of the two lane carriageway (see section 2.5)

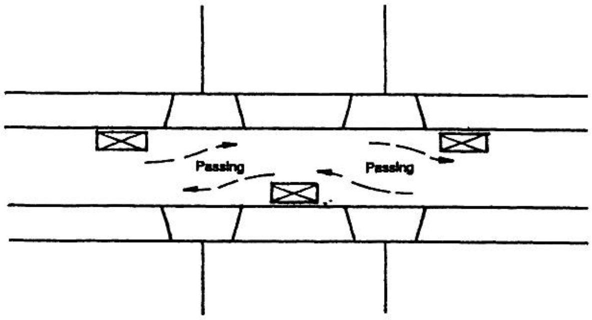


Fig. 2.6.C

For larger lot frontages there is a limited scope to reduce the carriageway somewhat in the upper catchment, e.g. for frontages over 17m, Parking Demand of 0.5 cars per lot, and Catchment of 25 lots, the average width may be **1.75 lanes**.

Hence the carriageway could be narrowed to one lane over 25% of its length.

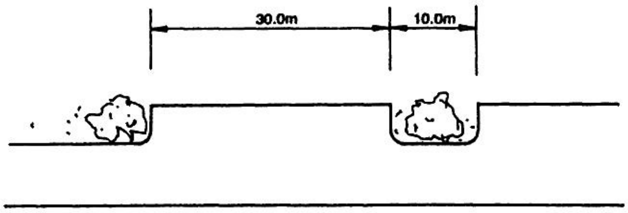


Fig. 2.6.D

CATCHMENT OVER 75 LOTS

For a catchment over 75 lots an average width in excess of two lanes is required, increasing up to 3.0 lanes at 300 lots catchment. However the minimum length of three-lane sections should be 35m to provide reasonable opportunities for unimpeded passing of opposing vehicles.

Of course the designer could take the easy way out, and use a constant Three-Lane carriageway for all streets over 75 lots, but this would be contrary to the principle of keeping carriageway widths to the minimum necessary.

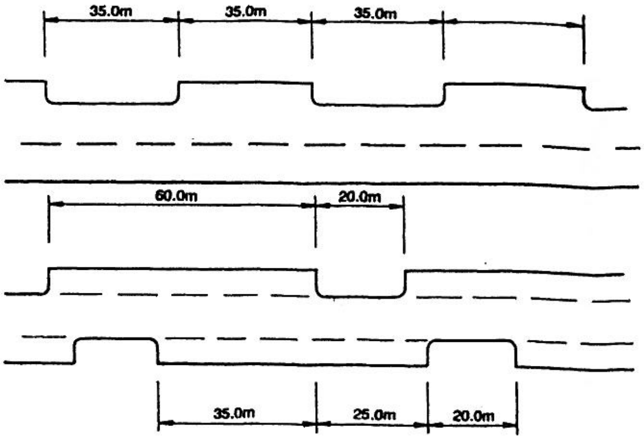


Fig. 2.6.E

Examplè:
For 190 lots catchment the required minimum Average Width is 2.5 lanes. This may be provided in a variety of configurations.

CARRIAGEWAY WIDTH

The full width of the carriageway on residential streets is usually multi-use, and "lanes" should not generally be delineated. Hence the **total** carriageway width at any point should be considered, rather than the sum of individual specific-purpose lanes.

Widths should be the minimum necessary for "normal" traffic movements, i.e. car passing car or cyclist, to be carried out at the design speed for the street, with "abnormal" movements, i.e. truck passing car or other truck, being possible but at reduced speed if necessary.

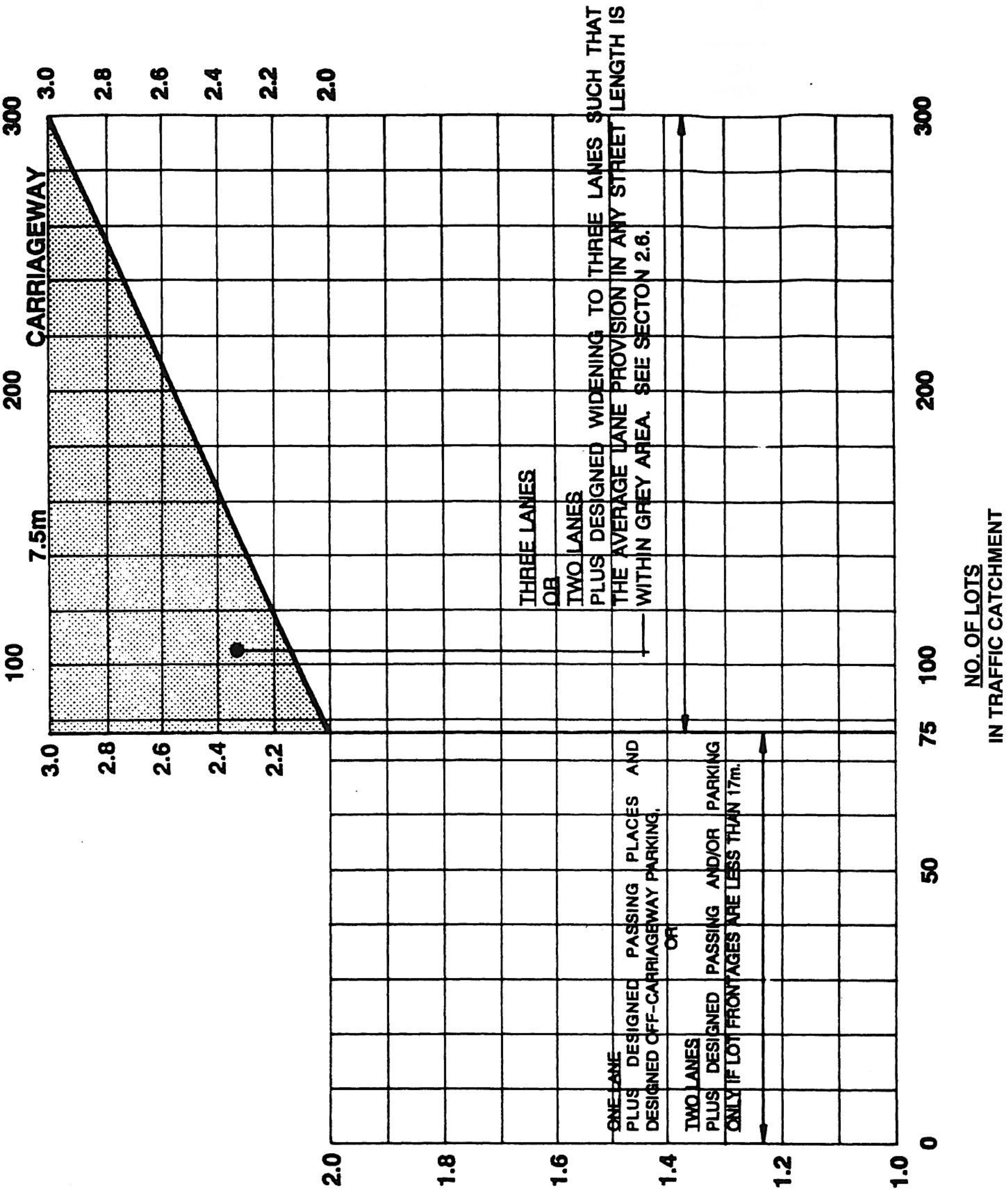
From Section 2.3 "Traffic Speeds", a practical Design Speed for a One or Two-Lane Street is 30 km/h, and for a Three-Lane Street is 40 km/h.

TABLE 2.6.F
CARRIAGEWAY WIDTH REQUIREMENTS

	10 km/h	20 km/h	30 km/h	40 km/h	50 km/h
Car/Cyclist	3.0	3.5	3.5	4.0	4.5
Car/Parked Car	4.0	4.5	5.0	5.5	6.0
Car/Moving Car	4.0	4.5	5.5	6.0	6.5
Car/Parked Truck (or v.v.)	4.5	5.0	5.5	6.0	6.5
Car/Moving Truck	4.5	5.0	6.0	6.5	7.0
Truck/Parked Truck	5.0	5.5	6.0	6.5	7.0
Truck/Moving Truck	5.0	5.5	6.5	7.0	7.5
Car/Two parked cars	6.5	7.0	7.0	7.5	8.0
Truck/Two parked cars	7.0	7.5	8.0	8.5	9.0

(Pak-Poy & Kneebone 1988)

Widths are for Drive-over type kerb, and are measured between channel inverts.



REQUIRED TOTAL LANES

LANE WIDTH REQUIREMENTS

Figure 2.6.G

From Table 2.6.F, and the foregoing criteria, the carriageway widths appropriate for various Lane Widths are:-

SINGLE-LANE CARRIAGEWAY

Primary Factor
Car passing cyclist at 30 km/h **3.5 m**
(Note: Any wider, e.g. 4.0 m would encourage attempts to use as two lane.)

TWO-LANE CARRIAGEWAY

Primary
Car passing moving car at 30 km/h **5.5 m**

Secondary
Truck passing truck at reduced speed
(Note: Any wider would encourage higher speed and attempts to use as three-lane. 5.0 m could be a valid alternative.)

THREE-LANE CARRIAGEWAY

Primary
Car passing two parked cars at 40 km/h **7.5 m**

Secondary
Truck passing two parked cars at reduced speed
(Note: Any wider would encourage higher speed. 7.0 m could be valid alternative.)

CARRIAGEWAY WIDTH

OBJECTIVES

* To provide sufficient width of carriageway and verge to allow streets to perform their designated functions within the street network. ***(AMCORD O1, page 60)***

* To minimise street construction and life cycle costs without compromising other objectives. ***(AMCORD O8, page 60)***

* Carriageway width to be sufficient to enable the street to efficiently and conveniently fulfil its required traffic and parking functions, but in the interests of safety, amenity and economy to be no greater than necessary for this purpose.

PERFORMANCE CRITERIA

* The number of vehicle lane widths in any street length to be sufficient to provide for:-
  - A single moving lane.
  - The design level of on-carriageway parking.
  - Reasonable opportunity for passing of opposing vehicles.

* Carriageway width to be the minimum necessary for normal traffic movements to be carried out at the design speed with abnormal movements possible at reduced speed.

ACCEPTABLE SOLUTIONS

* Carriageway width of each street length, in terms of the number of lanes, to be not less than as shown in Figure 2.6.G.

* Carriageway width (measured between channel inverts) to be:-

Single Lane- **3.5m**
Two Lane - **5.5m**
Three Lane - **7.5m**

STREET CLASSIFICATION 2.7

In traditional subdivision theory, there is a "hierarchy" of streets, gradually increasing in order of traffic importance from the short Cul-de-sac to the Arterial type roads.

This concept does not accord, however, with our philosphy that for **all Residential streets** the **"access"** function is paramount and the **"traffic"** function subservient. Nevertheless, the wider carriageways necessary for the higher traffic volumes within the acceptable range inevitably create a speed environment somewhat higher than that achievable on minor streets. Such slightly higher speed is also necessary to keep the total travel time within a lower-speed environment to an acceptable limit.

RECOMMENDED CLASSIFICATION

Hence, within the range of residential streets, a classification can be made, based on network function, carriageway width and design speed. Using generally accepted nomenclature, the recommended classification is:-

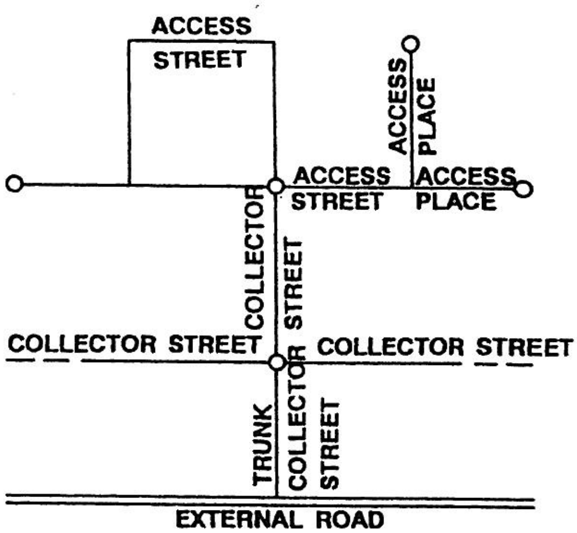
- **Access Place** — A single cul-de-sac street
- **Access Street** — A "stem" from which two or more cul-de-sac streets branch.

  In both cases — allotment catchment is less than 75 lots; carriageway width one or two lanes;

- **Collector Street** — A "branch" which connects to a major street or road;

  Total allotment catchment of 75 to 300 lots;

  Carriageway width two or three lanes;



STREET CLASSIFICATIONS

TRUNK COLLECTOR STREET

Section 3.0 identifies the need for a further class of street, for use where the traffic volume exceeds the maximum allowable for a street with direct frontage access of residential lots.

Such a street is termed a "Trunk Collector Street" (see Section 3.7 for full design requirements).

The Verge (or Nature Strip) is the area of the street reserve between the Property Boundary and the Carriageway.

The verge fulfils a number of **functions**:-

Safety visibility area
For drivers of vehicles on the carriageway to observe and react to pedestrians or cyclists exiting from dwellings onto the carriageway.

For drivers reversing from driveways to see traffic on the carriageway.

Parking
For vehicles clear of the carriageway, either in constructed parking bays, or on grassed areas in an "overspill" situation.

Landscaping
Space for landscaping to improve the appearance of the street environment.

Utility services
Location for services, clear of the carriageway.

Changes in level
Space for batters to provide for level differences between carriageway and allotments.

On higher volume/higher speed streets, the verge additionally provides for:-

Pathways
For pedestrians, and possibly cyclists.

Buffer area
For reduction in traffic noise level at dwellings.

SAFETY VISIBILITY

The **Time** available for the driver of a vehicle proceeding along the carriageway to respond to a "hazard" entering the carriageway from a dwelling depends on:-

- Speed of the "hazard" and
- Distance between point of first sighting and point of potential impact.

Whether this time is sufficient for the driver to stop the vehicle is dependent on the vehicle **speed.** Therefore as general rules:-

- **The wider the verge the better the driver's chance of stopping in time to avoid a hazard, and**
- **The higher the Design Speed of the street the greater the verge width required for safety.**

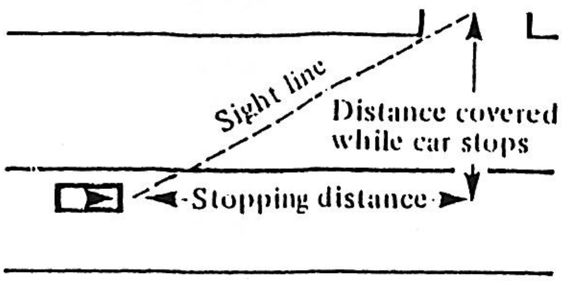


Fig. 2.8.A

The situation does not lend itself to a rigid analysis, as there are a number of factors outside the designer's control, e.g.

- Intervisibility between driver and "hazard" is variable with existence/height of front fences, landscaping within the verge and front yards of houses, and presence of parked cars.
- Speed of the "Hazard" may vary from (say) 2m/sec for a child running, up to perhaps 5 m/sec for a cyclist or skateboarder on a steep driveway.

In a worst case, of a cyclist exiting a steep driveway with high fences, landscaping on the verge, and an intervening parked car, the driver would have little chance of stopping in time, unless the verge were unreasonably wide.

Reasonable widths for design purposes are considered to be:-

DESIGN SPEED	VERGE WIDTH
30 Km/h	3.0m
40	3.5
50	4.0
60	4.5

These widths also provide sufficient width for a driver reversing from a driveway to see traffic on the carriageway before the rear of the car enters the carriageway (approximately 2.5m)

PARKING

This subject is fully dealt with in Section 2.4. However in regard to Verge Width it is noted that the minimum widths to accommodate various forms of verge parking are:-

- Indented bay, 90° - 7.0m
- Indented bay, parallel - 3.0m
- Informal verge "overspill" - 2.5m

A minimum clearance of 1.0m should be provided from the kerb line of an indented parking bay to the property boundary.

UTILITY SERVICES

It is highly desirable that utility services be **not** located under the carriageway, to avoid the necessity to excavate the carriageway for future repairs to services.

The minimum verge width to accommodated utility services will vary dependent on the Service Allocation Agreement current in the particular locality (see Section 5.2). However as residential streets do not normally have major trunk mains located within them, a width of **2.5m** is normally adequate to accommodate all required services.

However, services may be located under short indented parking bays and cul-de-sac heads, desirably in conduits to facilitate future replacement.

FOOTPATHS

While pedestrians (and cyclists) can safely share the carriageway with motor vehicles in low volume/low speed streets, on streets with higher traffic volume and speed, separate constructed footpaths for pedestrians must be provided within the verge.

The criteria for provision of pedestrian footpaths are detailed in Section 4.0.

Clearances required from the footpath are:-

Carriageway

To minimise the potential risk of a pedestrian stepping off the footpath into the path of a vehicle on the carriageway, the distance from the pathway to the carriageway should be greater in higher speed streets.

Recommended minimum distances are:-

DESIGN SPEED	**CLEARANCE** (Edge of pathway to the channel invert)
30 km/h +	1.0m #
40	1.5
50	2.0
60	2.5

NOTES:

+Footpaths are not normally required in streets with this Design Speed.

#The minimum of 1.0 m is to provide clearance for opening car doors, cars partially parked on the verge, and streetlight poles. Where parking bays are indented, the minimum of 1.0 m may be provided to the edge of the parking bay, regardless of the street Design Speed.

Property boundary

Clearance is required between the edge of the footpath and the property boundary for:

- Safety from vehicles backing from driveways
- To be clear of the usual location of joint Telecom and electricity cables;
- Overhanging vegetation from within properties.

Recommended minimum clearance is **0.8 m**

Minimum verge width

The minimum verge width required to accommodate a constructed footpath 1.2 m wide is therefore:-

DESIGN SPEED	VERGE WIDTH
30 km/h	3.0 m
40	3.5
50	4.0
60	4.5

These widths conform also with the total verge widths recommended from safety considerations.

However, a greater verge width is highly desirable to allow "meandering" of the footpath alignment relative to the kerb line and occasional consolidated areas of landscaping (see Figure 2.9.A).

CYCLEPATHS OR DUAL-USE PATHS

These paths are normally required only on higher speed streets.

Recommended minimum clearances are:-

- **Carriageway**
  As for Footpaths.
- **Property Boundary**
  Minimum 1.0m.

For a standard 2.0m width path, the required minimum verge width will be 1.0m greater than that required for a Footpath.

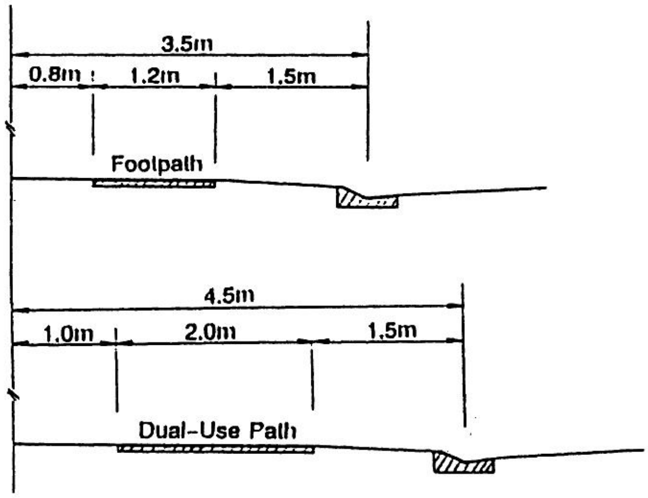


Fig. 2.8.B

VERGE CROSSFALL

Factors requiring consideration in selection of the verge crossfall are:-

Drainage

Surface must have sufficient grade to provide drainage, say 1:40 (2.5%) minimum.

There must be sufficient rise from the top of the kerb to provide reasonable capacity within the carriageway for overland stormwater flow - say 100 mm minimum.(recommended by Qld Urban Drainage Manual - 1992)

Vehicle Access to Lots

Changes of grade across the verge must not be so severe that vehicles cannot easily enter allotment driveways without scraping on the kerb or road.

Pedestrian Movement

A relatively level width must be provided for pedestrians, whether or not a paved footpath is constructed initially
- say 2.0 m width.

Parking

To accommodate emergency or over-spill parking a relatively level area must be provided immediately behind the kerb
- say 2.0 m width.

Figure 2.8.F shows cross-sections which satisfy the above criteria.

The maximum natural surface crossfall on which these standard cross-sections can be applied, with accesses graded to natural surface at the standard Building Line (6.0 m inside lots), is approximately **1 in 8.**

STEEP CROSSFALL

On steeper natural surface crossfall, special design solutions must be applied, such as:-

Split-Level Street

With two one-way carriageways at different levels.

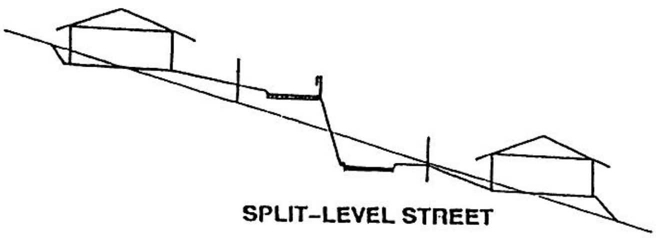


Fig. 2.8.C

Single-sided Street

With lots on one side only.
This is generally a better solution than a split-level street, as a narrow single-lane carriageway may generally be used for each street, avoiding the retaining wall normally required with a split-level street.

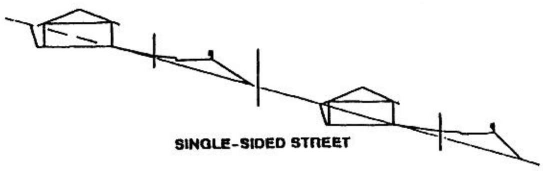
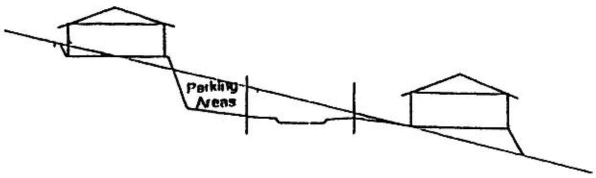


Fig. 2.8.D

Excavated Parking Areas

On high-side lots. These may be converted to garages with zero set-back in future construction.



EXCAVATED PARKING AREA

Fig. 2.8.E

VERGE

OBJECTIVES

To provide a buffer area between the street carriageway and the residential allotments, sufficient for the functions of Safety, Amenity and Convenience, but in the interests of Economy of no greater width than necessary.

PERFORMANCE CRITERIA

Verge Width adequate for:-

- Safety Visibility
- Pedestrian Movement
- Landscaping for amenity
- Noise reduction
- Parking
- Allotment access
- Utility services

Verge Crossfall suitable for:-

- Allotment access
- Pedestrian movement
- Drainage
- Overspill parking

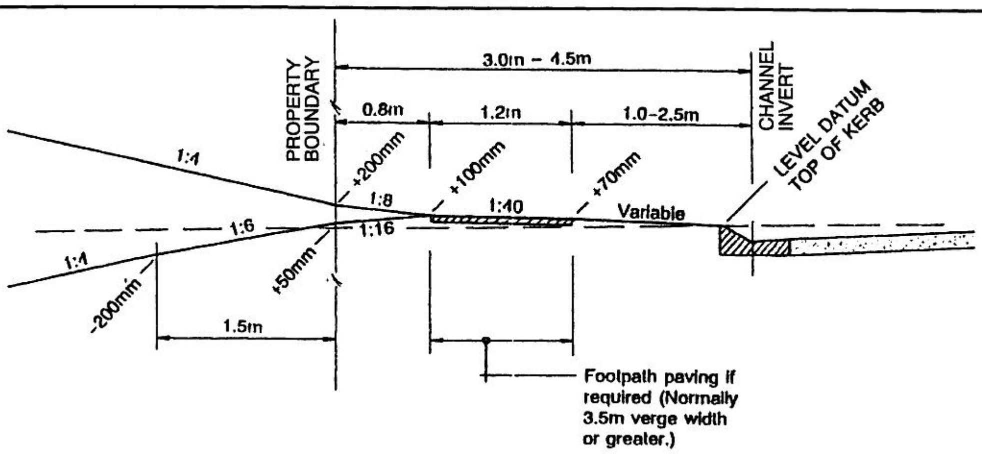
ACCEPTABLE SOLUTIONS

Minimum verge width

Access Place	-	3.0m
Access Street	-	3.0m
Collector Street	-	3.5m

Verge Cross-Section

As per Figure 2.8.F



MINIMUM VERGE CROSS-SECTION Fig 2.8.F

STREET RESERVE WIDTH

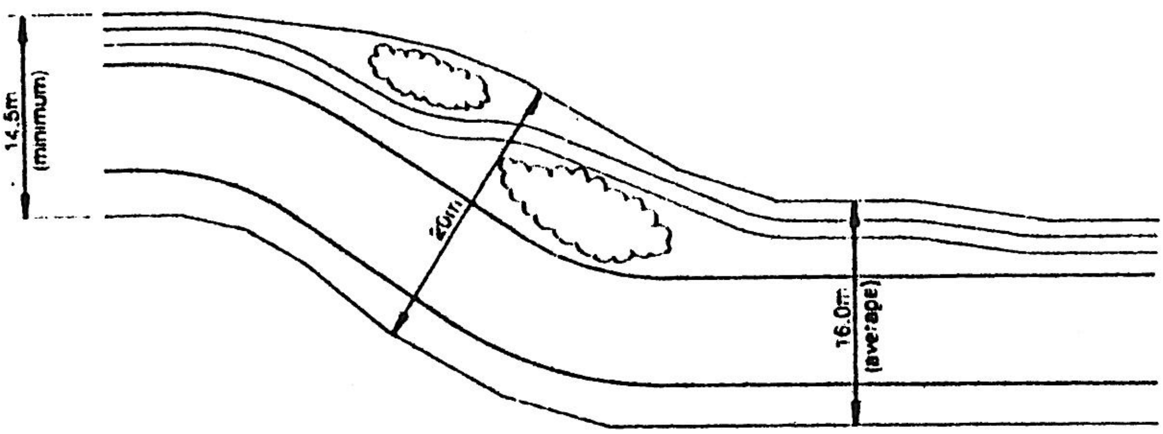
In traditional subdivision design, street reserves are a constant width, specified for each street category.

However, there is no intrinsic merit in a constant width, and it is aesthetically more pleasing to have a variable width with occasional wider areas to accommodate massed landscaping, parking areas etc., and to allow the footpath to "meander" relative to the kerb and property lines.

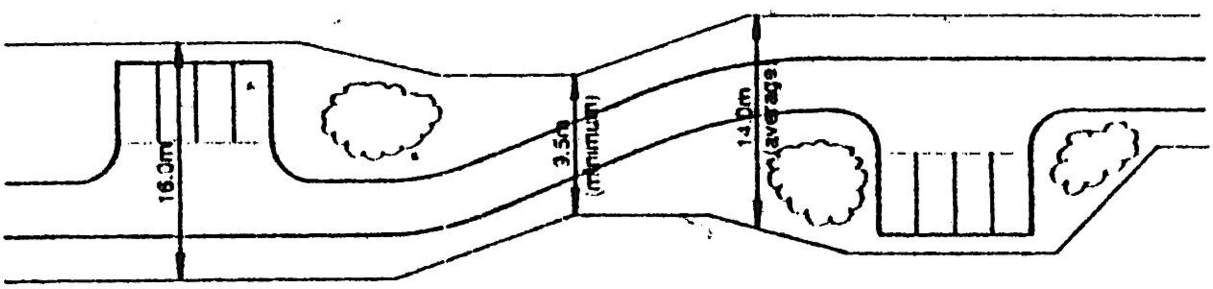
The **minimum** reserve width at any point will be the sum of the applicable carriageway and verge widths at that point.

The **nominal** reserve width can be considered as the **average** reserve width for initial planning purposes, and for assessing that a reasonable total reserve area has been provided.

Examples of the concept of Nominal Reserve Width are shown in Figure 2.9.A.



COLLECTOR STREET



ACCESS PLACE

VARIABLE STREET RESERVE WIDTH
Fig. 2.9.A

STREET RESERVE WIDTH

OBJECTIVES

* Appropriate street reserve width to be provided to enable the safe location, construction and maintenance of required paths and public utility services (above or below ground) and to accomodate the required level of landscaping. ***(AMCORD P6, page 62)***

* In the interests of economy, street reserve width to be no greater width than necessary.

PERFORMANCE CRITERIA

* **Minimum** street reserve width at any point to be not less than the sum of the minimum widths for the Carriageway and the Verge, as identified in Sections 2.6 and 2.7.

* **Average** street reserve width to be sufficient to provide varied reserve width to allow for landscaping, parking areas, etc.

ACCEPTABLE SOLUTIONS

* **Minimum Reserve Widths**

3.5m carriageway no parking provision

3.5 + 2 x 3.0	=	9.5 m
90° parking		
12 + 1 + 3.0	=	16.0 m

5.5m carriageway parallel parking

5.5 + 2 x 3.0	=	11.5 m

7.5m carriageway parallel parking

7.5 + 2 x 3.5	=	14.5 m

* **Average Reserve Width**

Access Place	-	14.0 m
Access Street	-	14.0 m
Collector Street	-	16.0 m

DESIGN SPEED

From Section 2.3 "Traffic Speed" it is concluded that:-

- **30 km/h** is the lowest practical Design Speed for Residential streets, and also the **desirable maximum** speed.
- **40 km/h** is the **highest acceptable** speed, from consideration of pedestrian and cyclist safety, for streets with residential access.
- Design speeds higher than the desirable maximum speed may need to be accepted in higher-order streets, (i.e. Collectors and Trunk Collectors) to keep total travel times to reasonable limits, and from practical design limitations.

RECOMMENDED DESIGN SPEEDS

From these considerations recommended Design Speeds for Residential streets are:-

- **Access Place and Access Street - 30 km/h**
- **Collector Street - 40 km/h**
- **Trunk Collector Street (no frontage access) - 60 km/h**

It must be remembered that these are **Design Maximum Speeds,** and not design minimum speeds as in Highway design practice.

SIGHT DISTANCE

Sight distance requirements are dependent on the distance required for the driver of a vehicle travelling at the relevant speed to react to the situation, apply the brakes, and for the vehicle to stop.

Sight distances required for various situations are specified in following sections. However, as all residential streets (other than Trunk Collector Streets) operate on the concept of a "single moving lane", the **General Minimum Sight Distance** is that required for the drivers of two opposing vehicles to see each other in sufficient time to stop before collision. This distance is twice the above Stopping Distances, measured between "eye heights" each 1.15 m above the carriageway.

The Stopping Distance and General Minimum Sight Distance for various vehicle speeds are:-

Speed	Stopping Distance	General Minimum Sight Distance
20 km/h	10 m	20m
25	15	30
30	20	40
35	25	50
40	30	60
50	40	80
60	55	110

Table 2.10.A
Stopping Distance and General Minimum Sight Distance

HORIZONTAL ALIGNMENT

As discussed in Section 2.3 "Traffic Speed", drivers react to restrictive horizontal alignment by slowing to an appropriate speed. Hence the desired maximum Design Speed is maintained by deliberately designing a restrictive horizontal alignment.

Quantitative details for alignment design on these principles are given in Section 2.3.

SHARP CURVES

While the use of sharp horizontal curves is one means of limiting vehicle speed, the following requirements should be complied with to allow safe passing and operation of the occasional heavy vehicle:-

- **Minimum Curve Radius**
  (carriageway centreline)
  Access Place or Access Street - 10m
  Collector Street - 15m
- **Carriageway Widening**
  Curve radius - 30m to 20m - 0.5m
  - Less than 20m - 1.0m

Carriageway widening applies to all standard carriageway widths. Widening should be applied to the **inside** kerb line of the carriageway, most simply by using a larger radius for the inner kerb.

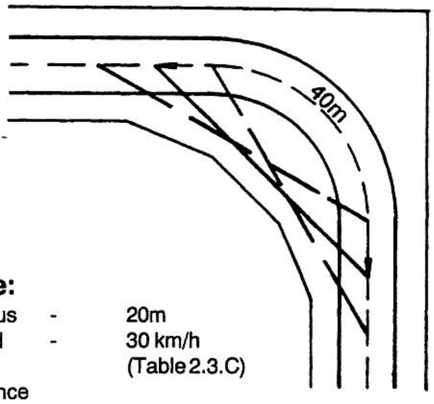
Single-lane (3.5m) carriageways will generally need to be widened to two lanes on sharp curves, to conform with requirements for intervisible passing spaces (see Section 2.5). In such cases the required carriageway width will be 5.5m plus appropriate widening.

SIGHT DISTANCE

The minimum horizontal sight distance required at any point along the street is **the General Minimum Sight Distance for the Spot Speed** relevant at that point.

The Sight Distance required is measured along the vehicle path.

Drawing the lines of sight between a number of pairs of points, the distance between each pair being the required Sight Distance, defines the "sight distance envelope", required to be left clear of obstructions to visibility.



Example:
Curve radius - 20m
Spot speed - 30 km/h (Table 2.3.C)
Sight distance required - 40m

measured along the vehicle path, between points 1.15m above the carriageway.

Fig. 2.10.B
Horizontal Sight Distance

GRADES

The maximum longitudinal grade on any street should desirably not exceed **12%**, from consideration of pedestrian walking convenience.

The **General** maximum grade for all streets is - **16%.**

However, where this grade cannot be reasonably attained, a steeper grade may be used over short lengths on Access Streets and Access Places.

The minimum longitudinal grade, based on drainage requirements and construction tolerances is **0.30%.**

VERTICAL ALIGNMENT

CREST CURVES

The controlling factor in the design of crest vertical curves is the provision of **adequate sight distance.**

In contrast to horizontal alignment, Vertical Alignment is **not** readily recognised in advance by drivers, and hence it is considered desirable that the vertical alignment provide if possible that all **Crest Vertical Curves** have a general minimum Sight Distance of twice the stopping distance for the **Design Speed** of the street, viz:-

- **Access Place and Access Street - 40 m**
- **Collector Street - 60 m**
- **Trunk Collector Street - 110 m**

These distances being measured between points 1.15 m above the carriageway.

However, if this is difficult to achieve in specific situations, it may be acceptable to provide as an **absolute minimum** twice the stopping distance for the **Spot Speed** at that point, as assessed from the horizontal alignment.

The minimum crest vertical curves to satisfy the above criteria in most situations are:-

Speed (Design or Spot as appropriate)	**Curve Radius**
20 km/h	44 m
30	174
40	392
50	695
60	1315

Table 2.10.C

For **short vertical curves** (length less than sight distance) lesser radii are required to provide the necessary sight distance as shown in Figure 2.10.K.

Requirements in terms of **Vertical Curve Length** are shown in Figures 2.10.G and 2.10.J.

In addition to the above **General Minimum** sight distance, which is required to be provided at all points along the street, at locations where there may be channelisation or line marking, such as intersections or pedestrian crossings, it is desirable that the driver be able to see such indications within his stopping distance, i.e.

Sight distance from 1.15m eye height to zero is not less than single-vehicle stopping distance.

In most cases the minimum vertical curve to satisfy this requirement is identical with that required by the **General Minimum** sight distance. However for short vertical curves a more generous curve may be required in this situation.

The requirements in terms of curve radii are shown in Figure 2.10.K, and in terms of curve length in Figures 2.10.G and 2.10.J.

It is noted that the above crest curves also satisfy the general **safety requirement** of providing stopping sight distance from 1.15m eye height to an object height of 0.2m above the carriageway.

SAG CURVES

While streetlighting is provided in all Residential Streets, the level of illumination is insufficient to be relied on for stopping distance considerations.

For **Sag Vertical Curves** therefore the critical factor is **Headlight Sight Distance**, the minimum vertical curve radius to be such that a vehicle's headlights will illuminate an object on the carriageway in time for the driver to stop.

The required minimum vertical curve radii are:-

Speed (Design or Spot as Appropriate)	Curve Radius
20 km/h	55 m
30	185
40	360
50	560
60	900

Table 2.10.D

Requirements in terms of **minimum sag curve length** are shown in Figures 2.10.H and 2.10.J.

It is noted that the above Headlight Sight Distance criteria also satisfy **"Comfort Criteria"**, providing vertical acceleration of less than 0.05g for speeds of 30 km/h and above and less than 0.1g for 20 km/h.

APPEARANCE CRITERIA

At small changes of grade a vertical curve in excess of the above minimum requirements may be preferable from appearance considerations.

Recommended minimum lengths are:-

Access Street and Access Place	-	**20 m**
Collector Street	-	**25 m**
Trunk Collector Street	-	**30 m**

Table 2.10.E

Combination Grading

While the previous design criteria give the requirements for individual crest and sag vertical curves, combinations of adjacent vertical curves in close proximity require checking graphically on the street longitudinal section to ensure compliance with sight distance requirements at all points.

CROSSFALL

The minimum carriageway crossfall, from surface drainage considerations is 0.025 m per m, i.e. **1 in 40.**

Maximum crossfall, from considerations of driver comfort, opening of car doors, and allotment access, should not normally exceed 0.040 m per m, **1 in 25.**

CARRIAGEWAY CROSS-SECTION

The form of carriageway cross-section may be:-

- **Centre Crown** - The "conventional" section, graded from a high point on the centreline to channels each side.

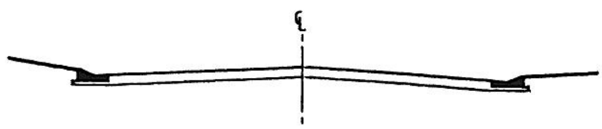


Fig. 2.10.D

This is the preferred section for wider carriageways e.g. **Collector Streets**, as it keeps the travelled centre lane clear of stormwater flows.

- **One-Way Crossfall** - Graded from a high point at one edge (generally kerb only) to a channel at the other edge.

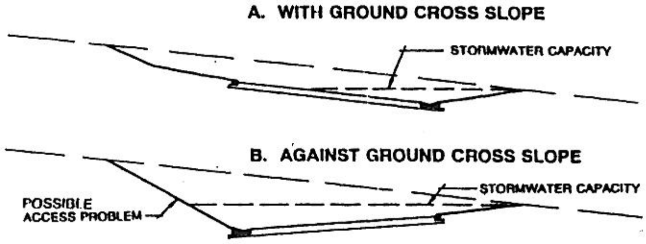


Fig. 2.10.E

Features of this Section are:-

- Appropriate for narrower carriageways, e.g. **3.5m or 5.5m Access Places or Access Streets only.**
- Simple to construct and economic to drain.
- Crossfall **with** the ground cross slope minimises earthworks and assists vehicle access to properties, but crossfall **against** the ground cross slope provides maximum stormwater capacity within the carriageway and provision for high side house roof drains.

- **Centre Channel** - Graded from each edge to a channel on the centreline, generally with flush edge strips either side.

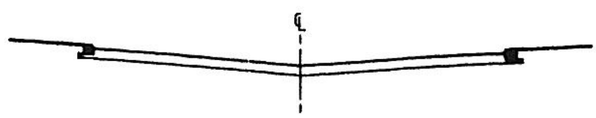


Fig. 2.10.F

- A possible alternative for intermediate width minor carriageways, e.g. **5.5 m Access Places or Access Streets only.**
- Provides good visual integration of carriageway and verge.
- Difficult to construct satisfactorily on flat grades, except in concrete or block paving, inefficient drainage collection on steep grades, and full length under ground drainline required, for roofwater drains.

GEOMETRIC DESIGN

OBJECTIVES

- Geometric Design criteria for the detailed design of the street to provide Safety, Amenity and Convenience for all users, with maximum consistent Economy of construction and maintenance.

PERFORMANCE CRITERIA

- Speed restrictive alignment to restrict vehicle operating speeds to minimum practical, consistent with a reasonable travel time.
- Sight Distance-Sufficient for safe vehicle operation at the design speed.
- Grades-Sufficient for drainage of the carriageway, but otherwise minimum possible, for safety and convenience of all road users.
- Carriageway Cross-Section - Suitable for surface drainage, driver comfort, and allotment access.

ACCEPTABLE SOLUTIONS

Design Speed

• Access Place & Access Street	30 km/h
• Collector Street	40 km/h
• Trunk Collector Street	60 km/h

Sight Distance

- **General Minimum**
(Twice Stopping Distance 1.15m to 1.15m)

Horizontal

Spot Speed	Sight Distance
20 km/h	20 m
25	30
30	40
35	50
40	60
50	80
60	110

Vertical

Access Place and Street	40m
Collector Street	60
Trunk Collector Street	110

- **Special Situations** (Intersections etc)
  In accordance with Sections 2.10 and 2.11.

Horizontal Alignment

- Speed restrictive design in accordance with Section 2.3.

- Minimum curve radii and curve widening in accordance with Section 2.10.

Grades

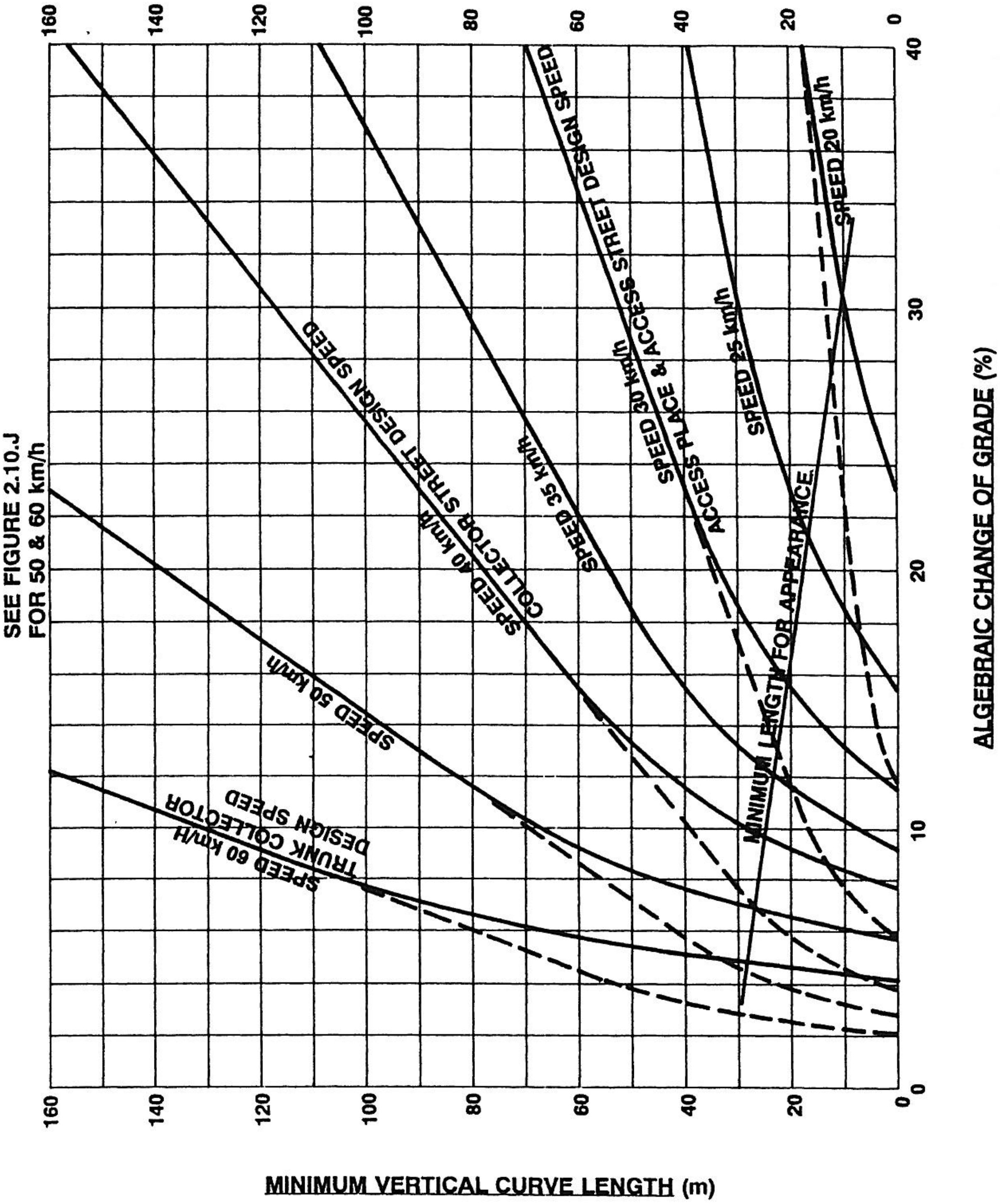
- **Desirable** maximum, all streets 12%
- **General** maximum, all streets 16%
- Absolute maximum, Access Places and Access Streets 20%
- Minimum, all streets 0.30%

Vertical Curves

- Minimum Radii and Lengths
  See Tables 2.10.C, 2.10.D, 2.10.E, and Figures 2.10.G, 2.10.H, 2.10.J and 2.10.K.

Carriageway Crossfall

- Minimum 1 in 40
- Maximum 1 in 25



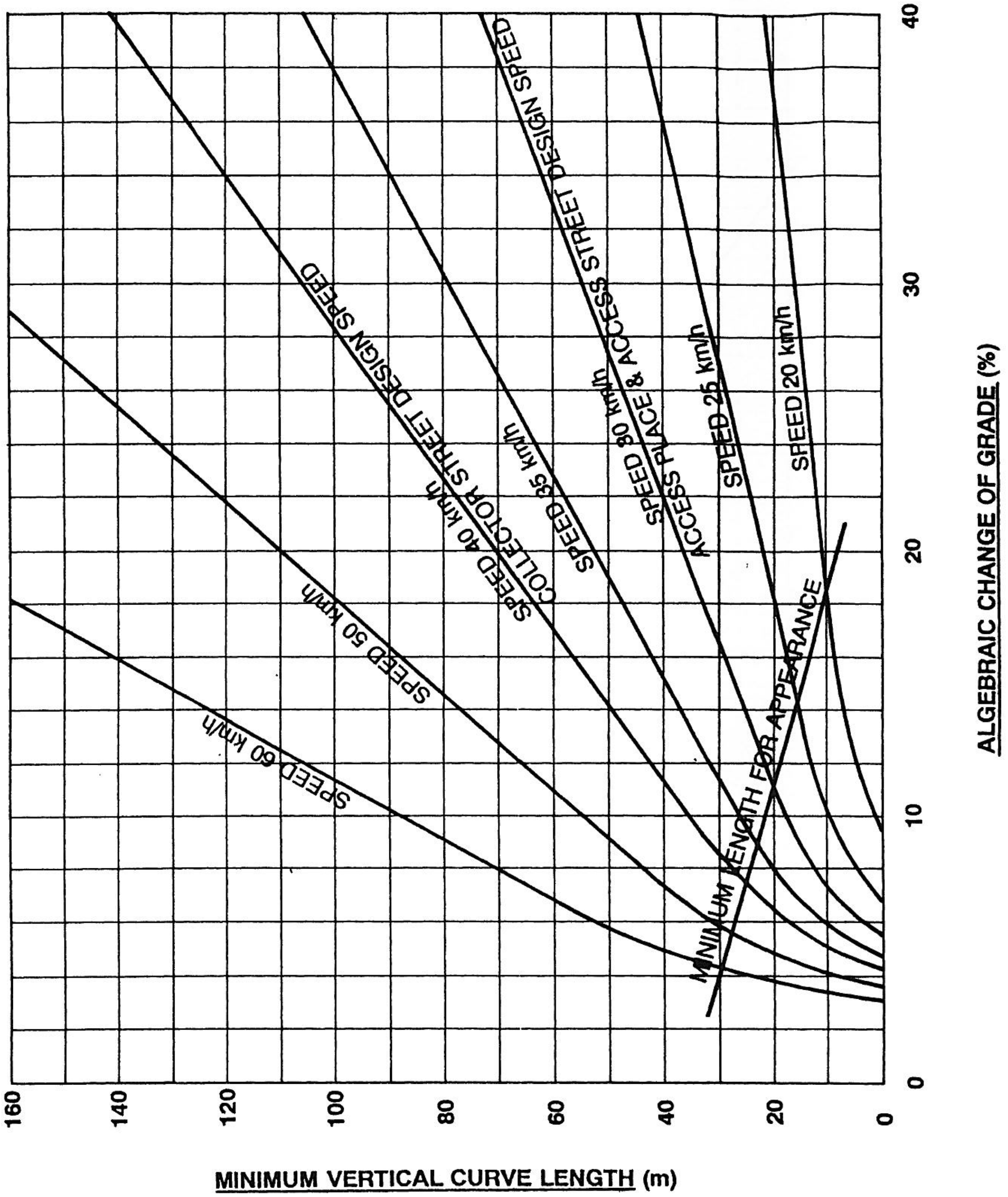
SIGHT DISTANCE TWICE STOPPING DISTANCE MEASURED 1.15m to 1.15m ————

SIGHT DISTANCE = STOPPING DISTANCE MEASURED 1.15m to 0.00m

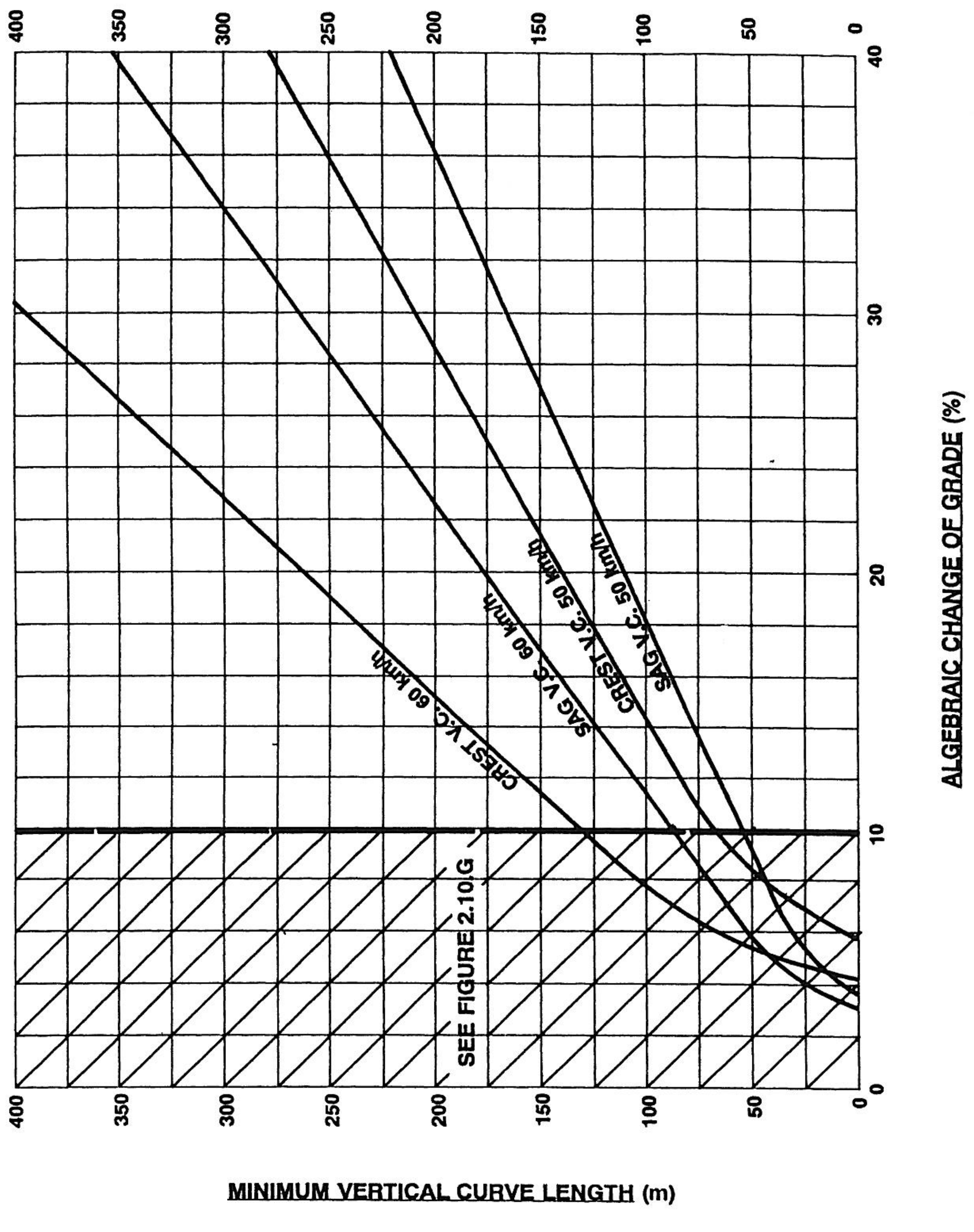
(a) CURVE LONGER THAN SIGHT DISTANCE ————

(b) CURVE SHORTER THAN SIGHT DISTANCE — — — —

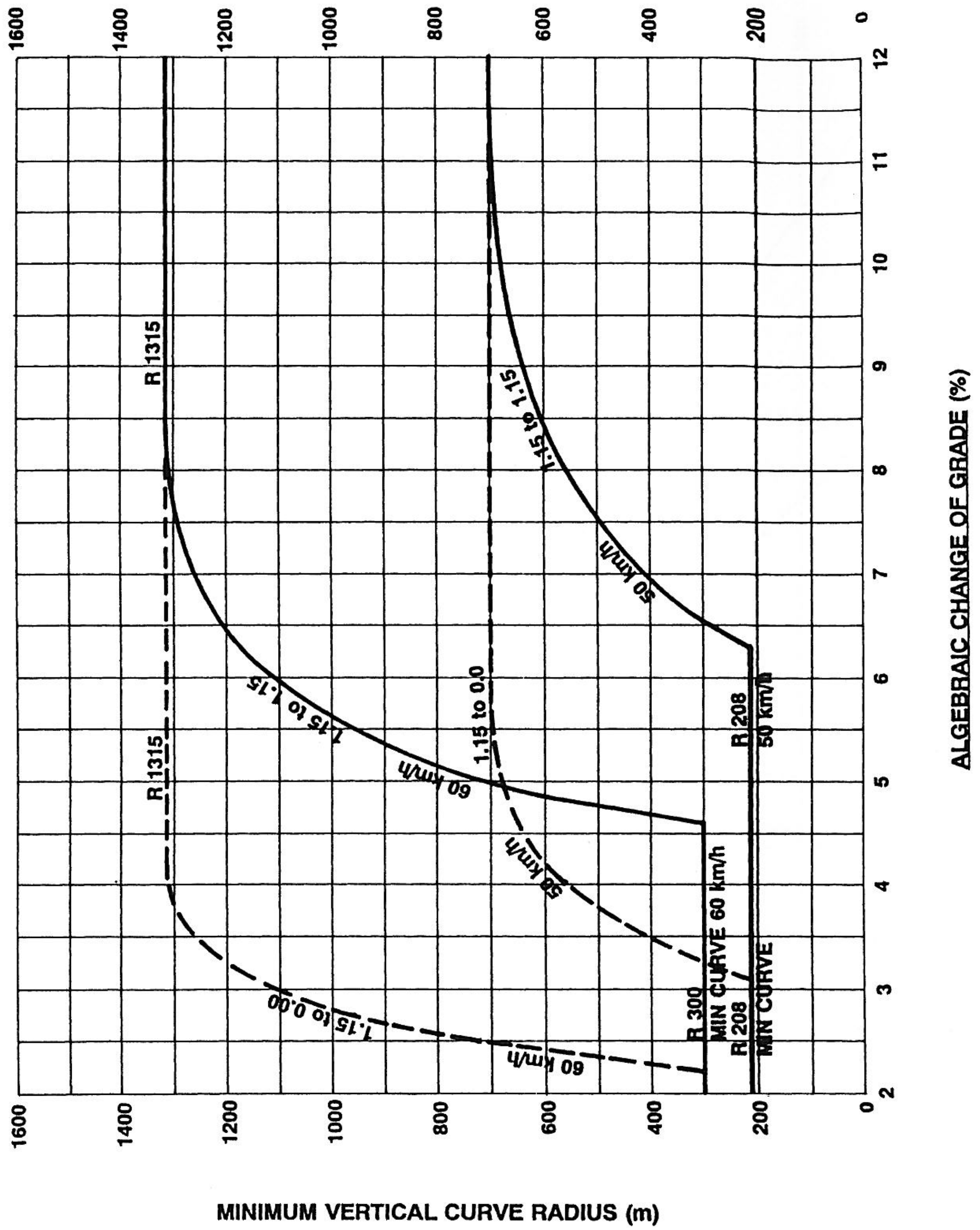
MINIMUM LENGTH OF CREST VERTICAL CURVE
FIGURE 2.10.G



LENGTH OF SAG VERTICAL CURVE
FOR STOPPING DISTANCE
WITHIN HEADLIGHT BEAM
FIGURE 2.10.H



MINIMUM LENGTH OF VERTICAL CURVES
FOR 50 km/h & 60 km/h
DESIGN SPEEDS
FIGURE 2.10.J

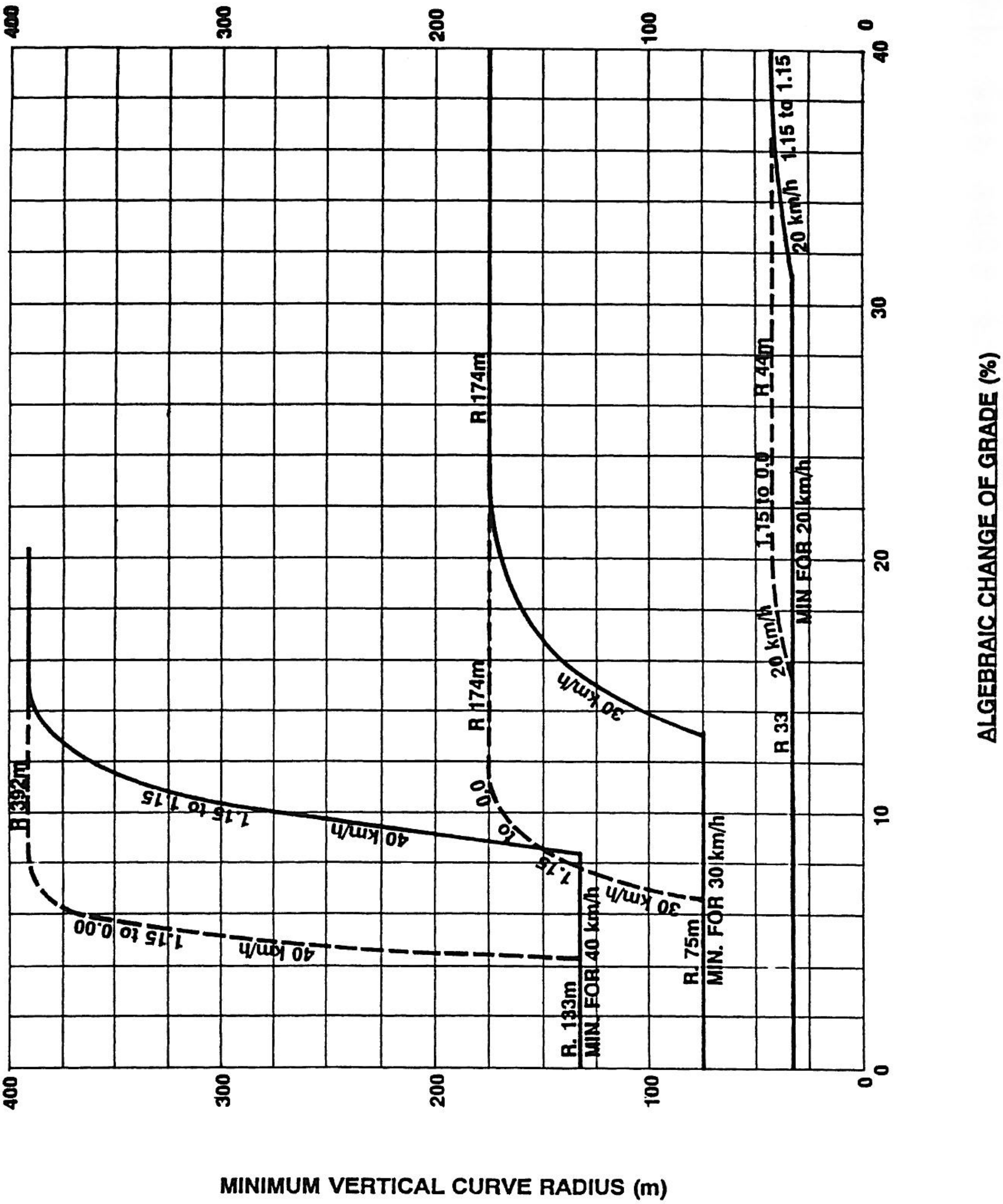


SIGHT DISTANCE TWICE STOPPING DISTANCE MEASURED 1.15m to 1.15m ————————

SIGHT DISTANCE = STOPPING DISTANCE MEASURED 1.15m to 0.00m — — — — —

MINIMUM RADIUS OF CREST VERTICAL CURVE FOR 50 km/h & 60 km/h DESIGN SPEEDS

FIGURE 2.10.K (a)



SIGHT DISTANCE TWICE STOPPING DISTANCE MEASURED 1.15m to 1.15m ————

SIGHT DISTANCE = STOPPING DISTANCE MEASURED 1.15m to 0.00m – – – – –

MINIMUM RADIUS OF CREST VERTICAL CURVE FOR 20, 30 & 40 km/h DESIGN SPEEDS
FIGURE 2.10.K (b)

Intersections have an obvious potential accident hazard, due to conflicting vehicle movements and the crossing requirements of pedestrians and cyclists.

Detailed design of intersections must provide for the reduction of these inherent hazards to a minimum, while providing for vehicles to turn easily from one carriageway to another.

Intersections also provide **opportunities,**

- To emphasise change of street status, when turning into a minor street.
- To act as "Slow Points", in maintaining a consistent slow speed (see Section 2.3 "Traffic Speed").

TYPES OF INTERSECTION

Within residential areas, appropriate intersection types are:-

- 'T' Junctions -(Three way)
- Roundabouts-(Three, Four or more).

Uncontrolled four-way intersections should **not** be used, due to their disproportionate accident risk, unless traffic volumes justify the use of signal control.

LOCATION OF INTERSECTIONS

NETWORK

Direct intersection of minor streets onto major streets or roads is **undesirable**, due to:-

- Increased number of intersections to major roads;
- Excessive difference in design speeds between the minor street and the major road, e.g. 30 - 80 km/h.

The higher design speeds of the Collector Street and Trunk Collector Street provide a gradation of speed environment between minor streets and the major road system.

In general, streets should intersect only with streets of the same or immediately adjacent classification:

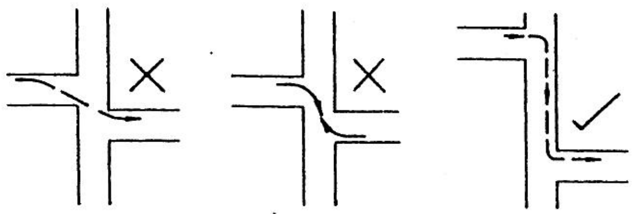
e.g.

- Access Place - only to Access Place or Access Street
- Access Street - only to Access Street, Access Place or Collector Street
- Collector Street - only to Collector Street, Access Street, or Trunk Collector Street
- Trunk Collector - only to Trunk Collector (unusual), Collector Street, or external Road.

SPACING

Intersections should be located sufficiently far apart to:-

- Separate traffic movements at each intersection
- Provide a reasonable time interval between driver decisions.



"DE-FACTO" 4 WAY JUNCTION — CONFUSION OF RIGHT TURNS — SUFFICIENT SEPARATION OF MOVEMENTS

Fig. 2.11.A

Desirable minimum intersection spacings (centre line to centre line) are:-

	Access Street & Collector Street	**Trunk Collector Street**
On same side of through street	60 m	100 m
On opposite sides of through street	40 m	60 m

A number of roundabouts in close succession can be unduly "fussy", and about **70m** is the recommended general minimum distance between roundabouts where there are three or more in proximity.

SIGHT DISTANCE

Provision of adequate sight distance is one of the major factors in safe intersection design.

Intersections should be located to maximise available sight distance, by avoiding locations such as the inside of horizontal curves, just past a sharp curve, or on the crest of a sharp vertical curve.

SIGHT DISTANCE CRITERIA

There are **two** sight distance criteria applicable to Residential Street intersections:-

- **Approach Sight Distance** (A.S.D.)
  This is Stopping Distance, from 1.15m eye height to zero on the street carriageway.

- **Safe Intersection Sight Distance** (S.I.S.D.)
  This is a recognition and reaction distance, applicable for drivers on the through street. It is numerically equal to the General Minimum Sight Distance, and is measured from 1.15m to 1.15m.

The A.S.D. should be provided on every leg of every intersection, while the S.I.S.D. is required only on the through legs of the intersection. However, the full length of each street is normally designed for the General Minimum Sight Distance (see Section 2.10), and the A.S.D. requires the same vertical geometry as the S.I.S.D. except on short vertical curves.

A third sight distance criterion is identified by NAASRA standards, "Entering Sight Distance" (E.S.D.). However, this is not relevant to Residential Street intersections.

Relevant design data is listed as follows:-

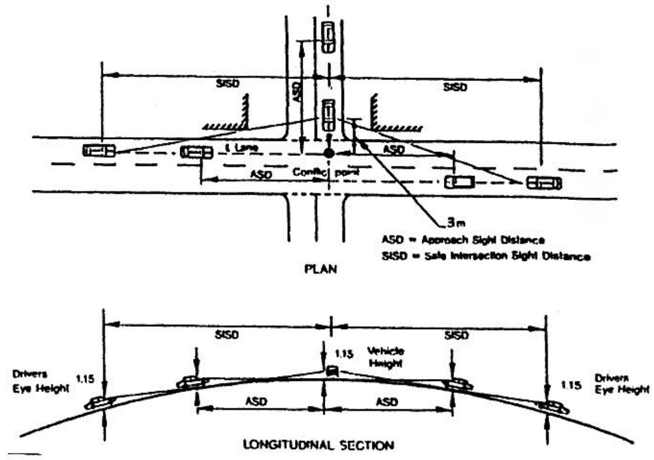
Stopping Distances	-	Table 2.10.A
Minimum Sight Distance	-	Table 2.10.B
Crest Vertical Curves	(Radii) -	Table 2.10.C
	(Radii) -	Figure 2.10.K
	(Length)-	Figures 2.10.G & .J
Sag Vertical Curves	(Radii) -	Table 2.10.D
	(Length)-	Figures 2.10.H & .J

The **Speed** used for ascertaining the required Sight Distance should desirably be the **Design Speed** for the street under consideration, but in constricted situations the Spot Speed as appropriate for the horizontal alignment at the location may be used.

SIGHT DISTANCE TRIANGLE

The required S.I.S.D. and A.S.D. should be available at any location within the "sight distance triangle" as shown in Figure 2.11.B, except that view blocks of small lateral dimension are permissible e.g. signs, poles, tree trunks, small shrubs.

In the case of a roundabout, the S.I.S.D. should be available from 3m behind each approach holding line.



Measurement of Sight Distance
Figure 2.11.B

T-JUNCTIONS

Alignment and threshold treatments of the approach streets should be such as to establish without any ambiguity the major street/minor street priority.

The angle between the street centrelines should be **90°**, unless some skewing is essential in which case the **minimum** angle is 70°. The minor street centreline should be straight for a minimum of 10 m from the tangent point of the kerb return.

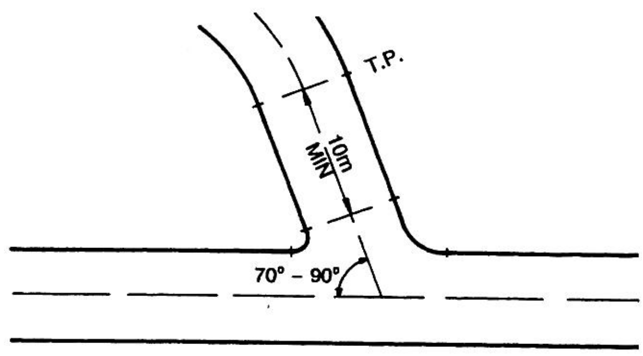


Fig. 2.11.C

Carriageway Width should be a minimum of 5.5 m in every leg of the intersection, i.e. 3.5 m carriageways should be widened to 5.5 m, for a minimum length of 10 m, to allow a vehicle to turn into the minor road even if another vehicle is standing in the minor road.

Kerb Radii should be the **minimum** appropriate for likely regular traffic in order to keep turning speeds at a reasonable minimum.

The design basis should be :-

Car - 7.5 m turn radius - Kerb lane to kerb lane

S.U. Truck - 12 m turn radius
- Full width of 5.5 m carriageways
- Centre lane of 7.5 m carriageway
- Kerb lane of Trunk Collector

For 90° intersection angle, the appropriate kerb radius for these criteria is:

Access Street, Access Place, Collector Street	-	6.0m
Trunk Collector	-	8.0m.

For other angles, turning templates or an appropriate computer programme (e.g. 'V-Path') may be applied using the above criteria, to determine appropriate radii.

Median Islands are not normally required in any residential street intersections, but may be included if desired for aesthetic purposes, or required for traffic reasons e.g. speed control or to clarify priority. In most cases islands will need to be mountable, to allow for turning by larger vehicles (see Section 2.13).

At intersections where a Pedestrian Route or Cycle Route cross, a median island can provide a refuge for pedestrians or turning cyclists.

Entry Treatment such as a change of pavement material or a strip of block paving, help to indicate the change of street status. A concrete "spoon" or "dish" drain across the minor road can serve both this and a drainage function.

ROUNDABOUTS

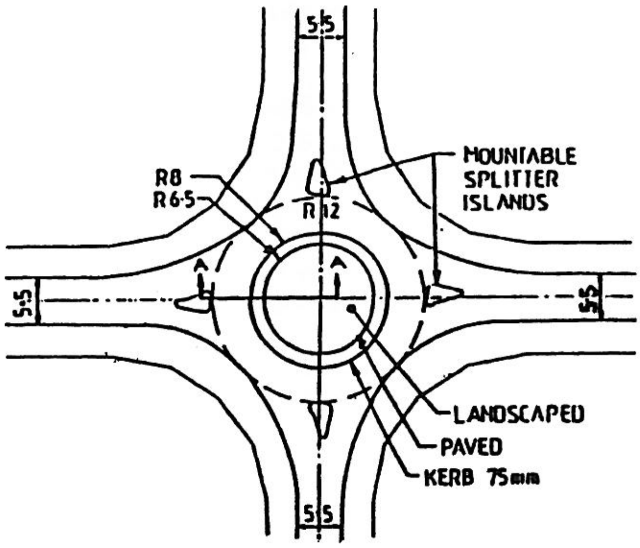
Roundabouts in residential streets offer additional flexibility in subdivision layout, as they can safely provide for four-way intersections.

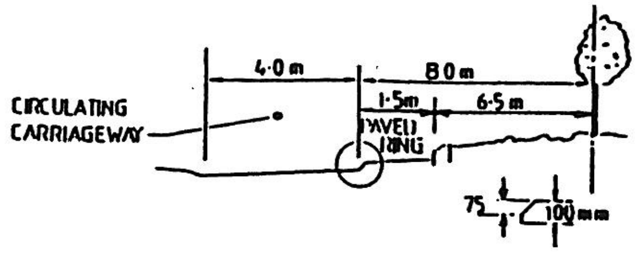
Their use is consistent with the philosophy of all streets being of equal (minor) traffic significance, and they act as "slow points" on all intersecting streets.

Splitter Islands are highly desirable in all roundabouts, but not essential in minor roundabouts.

Where speed control is a function, the **Geometric Design** for residential street roundabouts should generally be based on the **Design Car** with the occasional truck or bus being allowed to mount the centre island, and being provided for by a paved area behind the kerb of the island (see Section 2.13).

The design will generally be site-specific. However for minor roundabouts at 90° intersections, the following layout is typical:-





SECTION AA

Fig. 2.11.D

LIGHTING

All intersections are required to be effectively lit, generally in accordance with the criteria of Australian Standard AS.1158 "Code of Practice for Public Lighting - Part 1".

TRUNCATIONS

Truncation of property boundaries at intersections may be required for:-

- Intersection sight distance
- Maintaining verge width.

SIGHT DISTANCE

For a normal T-Junction with straight approaches at 90° sight distance does not require any truncation (see Figure 2.11.B). However, if the approach streets are curved, verge width at the intersection is reduced, or the geometry is otherwise abnormal, the sight distance should be checked, and the property boundary truncated if necessary to clear the sight triangle.

In the case of a Roundabout, all property boundaries will normally require truncation to clear the sight triangle.

VERGE WIDTH

A truncation of the property boundary is required at most intersections, to avoid a reduction in available verge width due to the radius of the kerb return at the intersection.

While the verge width will vary both with the street classification and the location of the carriageway within the street reserve, for standard 90° T-junctions a single chord truncation of 3.5m chord length may be used.

For non-standard situations (e.g. roundabout T-junction channelised, or at other than 90°) a truncation is required such that the verge width at the kerb return is not less than the verge width in either approach street.

INTERSECTIONS

OBJECTIVES

To provide intersections between streets with maximum possible safety and convenience of operation, with minimum possible construction and operation cost.

PERFORMANCE CRITERIA

- Safety of operation
  - Geometry clearly establishing approach vehicle priority.
  - Adequate approach sight distance.
  - Slow speed of negotiation, consistent with convenience.
- Intersections generally only between streets of the same classification, or classification one above or below.
- Sufficient spacing of intersections to avoid driver confusion.
- Design to reinforce street classification and network legibility.

ACCEPTABLE SOLUTIONS

- T-junctions or Roundabouts designed in accordance with Section 2.11, and with the principles of relevant NAASRA (Austroads) design codes.

Facility for vehicles to turn must generally be provided at the end of all cul-de-sac streets. However, the incidence of turning movements at the head of a cul-de-sac is not great, as resident and visitor cars parked within lots or driveways will typically back out, and turn to drive straight out of the street. Even parallel parked cars are more likely to do a "three-point turn" in a convenient driveway rather than drive to the end of the street to turn, unless they are parked close to the end.

Therefore service vehicles such as the garbage truck, milkman and other trade and delivery vehicles, casual visitors and a few residents' vehicles are the likely users of the turning facility.

The Garbage Truck is usually the significant vehicle for turning requirements.

An exception to the general requirement for provision of a turning facility may be a short "driveway" accessing (say) four lots maximum, where a turning facility may be deleted if:-

- Provision for collection of garbage satisfactory to the Local Authority is made (e.g. an area for residents to place bins at the intersecting street);
- Occasional reversing of a vehicle from the driveway is acceptable (e.g. onto a street with very low traffic volume, as is the case when a driveway extends from a cul-de-sac turning area).

DESIGN VEHICLES

Appropriate Design Vehicles for cul-de-sac turning areas are:-

- Within the Turning Area Carriageway
    - Local Authority's standard garbage truck
- Within the Street Reserve (mounting kerbs)
    - "Heavy Rigid Vehicle" (HRV-A.S.2890.1)

TYPES OF TURNING FACILITY

Turning facility may provide for either:-

- Single Movement turn, or
- Three Point Turn

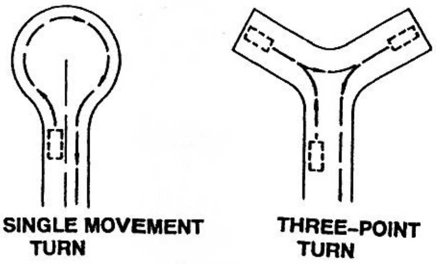


Fig. 2.12.A

SINGLE MOVEMENT FACILITY

"Traditional" turning provision is for Single Movement turns, by means of a turning circle of typically 16m to 18m kerb diameter. This is sufficient for cars and small delivery vehicles to turn in one movement, **provided** that there is no vehicle parked within the turning circle. However, such parking is a frequent occurrence, due to the limited frontage and hence reduced internal parking capacity of the lots around the cul-de-sac head.

When parking does occur, all vehicles must resort to a "three point turn" while larger vehicles must use this method even when the circle is clear of parked vehicles.

The large area of carriageway required by such a turning circle is visually unattractive, and uneconomic both in construction cost and land value.

A possible compromise is to include landscaping or parking bays in the centre of the circle to reduce the visual expanse of carriageway:-

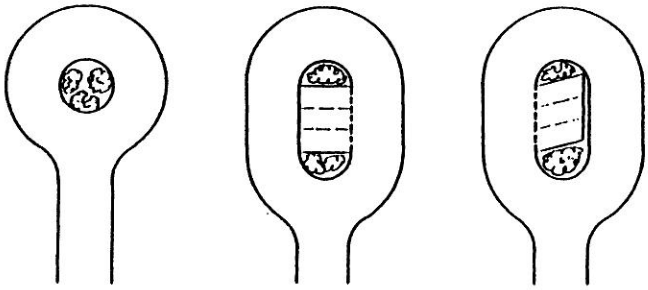


Fig. 2.12.B

THREE POINT TURN

"Three Point Turn" turning areas are generally the most economic of carriageway area and land area.

Possible configurations include:-

The angle between any two arms should be not less than 90°.

Turning Areas with non-standard geometry should be designed using turn templates or an appropriate computer programme e.g. 'V-Path'.

It is necessary to discourage parking from occurring in the turning areas.
Locating allotment driveways off the arms will have this effect, and some parking bays in close proximity will assist in ensuring that the turning area is left clear.

A minimum clearance of 2.5 m should be provided from the end of each arm to the property boundary, to prevent turning vehicles damaging fences or gates.

TURNING AREAS

OBJECTIVES

To provide for the turning of vehicles at the end of cul-de-sac streets with maximum safety and convenience of operation, visual and noise amenity, at minimum construction cost and land area requirement.

PERFORMANCE CRITERIA

- Area for either Single-Movement or Three-Point Turn to be provided at the end of every cul-de-sac.
- Turning area to accommodate design vehicle appropriate for the street.
- Turning area to have minimum necessary area of carriageway, and require minimum necessary area of land.
- Design to discourage parking within the area for turning movement.

ACCEPTABLE SOLUTIONS

- Standard turning areas as illustrated in Section 2.12, or designs which conform to criteria of Section 2.12.

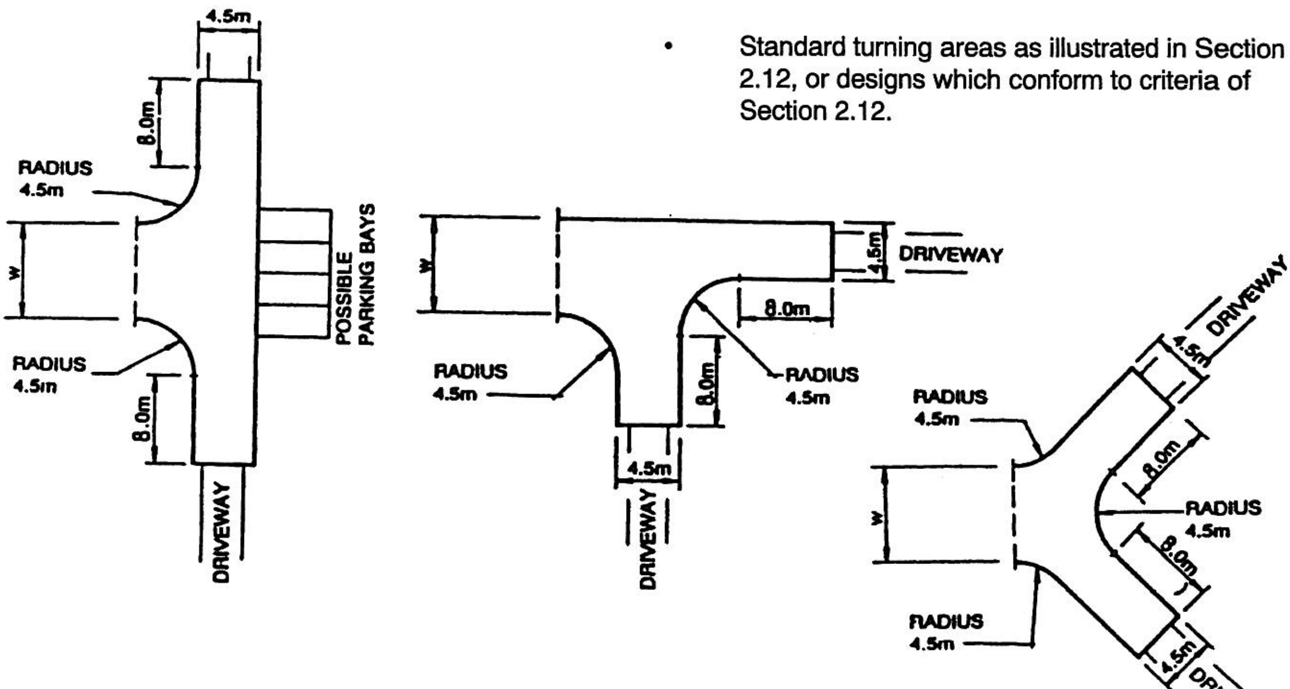


Fig. 2.12.C
Examples of Turning Areas

Speed control devices are physical construction features within the street carriageway for the purpose of controlling the speed of traffic.

NEED FOR DEVICES

One of the basic principles of residential street design is the limitation of vehicle speed at every location to an acceptable **Maximum Design Speed.**

The principal means of limiting speed is by restricting the length of straight (or nearly straight) street to the length in which a vehicle can reach the selected Design Speed (see Section 2.3.7).

In the majority of cases the Street Leg Length limitation will be provided by the subdivision layout, in the form of sharp bends or continuous curves in the horizontal alignment of the street. However there will be situations where this is neither possible nor expedient e.g. a single street down the centre of a relatively narrow parcel of land.

In such cases a **Speed Control Device** is a means of limiting the effective street length.

FACTORS IN SELECTION

There are a number of Speed Control Devices currently in use in Local Area Traffic Management schemes for the purpose of limiting traffic speed and/ or volume in existing streets.

In some cases these devices are less than ideal, due to limitations resulting from existing street width or driveway locations, but in new development, without such limitations, the street designer can be more selective in his choice of Control Devices.

Devices can be categorised according to their geometry as:-

- **Horizontal deflection** e.g. roundabouts, angled slow points, central medians;
- **Vertical displacement** e.g. road humps, raised thresholds.

It is considered that **Horizontal Deflection** devices are the more appropriate for new development as they are:-

- Highly visible, and hence
  - more likely to mitigate speed at a distance,
  - no warning signs are required, preserving visual amenity.
- Readily landscaped, to
  - enhance effectiveness,
  - enhance visual amenity.
- Less "aggressive" in their effect on traffic
- Less noise generating

DESIGN REQUIREMENTS

From Section 2.3, the approximate maximum Street Leg Length for an Access Street or Access Place is 75m and for a Collector Street 120m, assuming an "end condition" speed of 20km/h. An increase in end condition speed to 25 km/h reduces the allowable street leg length to approximately 45m and 80m respectively.

Hence to be effective, a Speed Control Device must have a very low negotiation speed, desirably 20 km/h, requiring a geometric design which is quite restrictive.

It is rarely feasible to design a device which will accommodate larger vehicles within the carriageway and still effectively control the speed of cars. Hence the general design principle is to design the kerblines to restrict cars to the design speed, necessitating larger vehicles to mount a kerb and traverse an appropriately paved area behind the kerb.

Kerbs which may be mounted by larger vehicles require to be of a height and profile which is a compromise between keeping cars to the carriageway while providing an acceptable ride for larger vehicles. 75mm has proved to be a reasonable kerb height for this purpose.

In general, such devices are **not** acceptable on bus routes, due to discomfort and possible injury to bus passengers. This highlights the desirability of locating bus routes only on Roads or Trunk Collector Streets (see Section 3.5).

APPROPRIATE DEVICES

The most appropriate devices for use in new development are considered to be:-

- Roundabout
- Central Median
- Driveway Link

ROUNDABOUT

At an intersection between a through street and a minor street, a Roundabout may be provided as a Speed Control Device for the through street where otherwise a "T" intersection would be acceptable.

When used as speed control devices, roundabouts will typically be similar to Figure 2.11.D.

CENTRAL MEDIAN

This device is appropriate on any residential street, and on Access Places and Access Streets also provides a "designed passing place".

The design should provide for maximum deflection of entry vehicle paths, easier exit and maximum restriction of through visibility. Hence the centre island should desirably be large enough for significant landscaping, say 3m minimum width. Figure 2.13.A shows a typical example.

DRIVEWAY LINK

This device is appropriate on Access Streets or Access Places.

As shown in Figure 2.13.B, offsetting the carriageway can fully block visibility through the device, thereby enhancing its effectiveness, and paired driveways can provide assured passing areas at each end of the device.

SPEED CONTROL DEVICES

OBJECTIVES

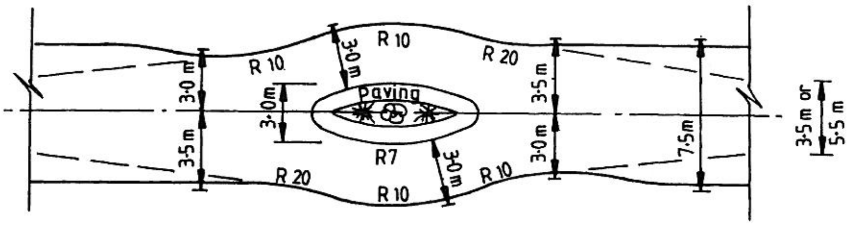
- To safely restrict maximum traffic speed at any point in the street to an appropriate limit.

PERFORMANCE CRITERIA

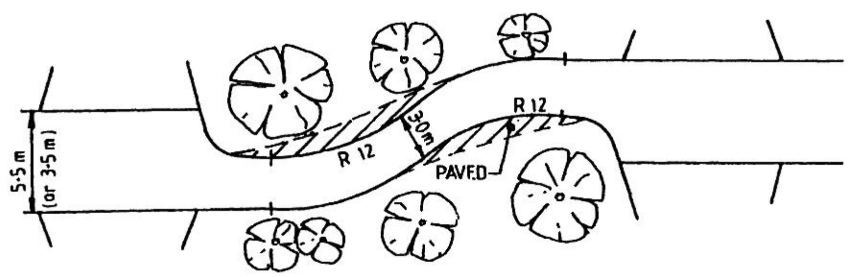
- Restriction of vehicle speed at any point in the street to the Maximum Design Speed appropriate for the street classification.

ACCEPTABLE SOLUTIONS

- Conformity with the principles of Section 2.13.
- Detailed design to reduce vehicle negotiation speed to 20km/h.



CENTRAL MEDIAN
Fig. 2.13.A



DRIVEWAY LINK

Fig. 2.13.B

SUMMARY OF STREET DESIGN CRITERIA 2.14

RESIDENTIAL STREETS

SUMMARY OF "DEEMED-TO-COMPLY" CRITERIA

	Access Place (1) and Access Street (1)	Collector Street	Trunk Collector Street
Traffic Catchment - max.	75 lots (2)	300 lots (2)	1000 lots (2)
Design Speed - max.	30 km/h	40 km/h	60 km/h
Carriageway - Lanes	1 or 2	3	2
- Width	3.5m or 5.5m	7.5m	8.0m
Verge Width - min.	3.0	3.5m	4.5m
Reserve Width - Average	14.0	16.0m	20m
Kerbing	Driveover Type	Driveover Type	Driveover Type or Swale Drains
Footpaths/ Cyclepaths	Not Required (3)	Footpath one side (3)	Footpaths/ Cyclepaths- both sides (8)
Parking	Carriageway and/ or indented bays	Carriageway and/ or indented bays	No provision (9)
Grade - max.	16%	16%	16%
- min.	0.30%	0.30%	0.4%
Sight Distance - general min.	40m	60m	110m
Carriageway	One or Two Way	Two Way	Two Way
Crossfall	Min. 1:40 Max. 1:25	Min. 1:40 Max.1:25	1:40

Notes:

1. Difference is in subdivision layout only, not in street design.
2. Based on 10 v.p.d. per Single dwelling Residential Lot. Traffic generated for other uses **must** be assessed in accordance with Section 2.2.6.
3. Typical only - varies with pedestrian/cyclist network planning.
4. Since no direct frontage of residential lots permitted.

SECTION 3.0 - THE STREET SYSTEM

3.1 THE STREET SYSTEM

Having considered the design requirements of the individual Residential Street, the next step is to consider the aggregation of a number of streets into a Residential Area, and their connection to the Road system.

3.2 THE RESIDENTIAL NEIGHBOURHOOD

DEFINITION

A "Residential Neighbourhood" may be defined as a homogeneous residential area, with community of interest, and which is largely self-contained.

Facilities such as a small shopping centre, primary school and neighbourhood park will generally be provided within the area.

Neighbourhood boundaries are generally clearly defined barriers to movement, such as

* Major Roads
* Railways
* Rivers or creeks

SIZE OF NEIGHBOURHOODS

The areas and dimensions of individual neighbourhoods will inevitably vary quite considerably due to topography and the location of boundary roads.

However, one obviously desirable feature is that each Neighbourhood be capable of supporting its own Primary School, as this means that primary school children, (who are among the most vulnerable group for traffic risk) need not cross a major road on their trip between home and school.

The Department of Education criteria for a primary school "catchment" are:-

* Maximum catchment - 1800 allotments
* Minimum catchment - 1200 allotments

The Neighbourhood areas which would result from applying these criteria will vary with the density of residential development, but typical figures are:-

Conventional Allotments	**Maximum 1800 lots**	**Minimum 1200 lots**
Approx. 10 lots per ha (gross)-	180 ha (eg 1350m x 1350m)	120 ha (eg 1100m x 1100m)

Smaller allotments (typically 450m²)	**Maximum 1800 lots**	**Minimum 1200 lots**
Approx. 12 lots per ha (gross)	150 ha (eg 1225m x 1225m)	100 ha (eg 1000m x 1000m)

These dimensions are reasonably consistent with the generally accepted recommendation for the spacing of Major Roads, i.e. 1500m (see Section 6.0).

If neighbourhoods are sized towards the above **upper** limit this will result in:-

- Minimum cost of Arterial Road infrastructure
- Less likelihood of future loss of school viability (from the normal drop in school enrolment as the neighbourhood population ages).

The resultant neighbourhood population, of about 5400 (1800 x 3.0), is also generally considered sufficient to support a local shopping centre.

Hence the criterion of **1800 allotments** is considered a reasonable optimum for determining Neighbourhood areas.

OPTIMISING NEIGHBOURHOOD AREAS

While natural barriers and major transport routes such as railways or highways are generally beyond the designer's control, the location of some planned roads may be variable within limits to assist in creating viable Neighbourhoods.

Planned Sub-Arterial roads particularly may generally be varied to suit neighbourhood area criteria. For example, to subdivide a larger area an additional Sub-Arterial can be provided.

On the other hand, it is not essential that a Neighbourhood have roads on all four sides. Natural features or Park strips may form a boundary on one or more sides.

Insert an Extra Sub-Arterial Road **Accept Roads on Three Sides Only**

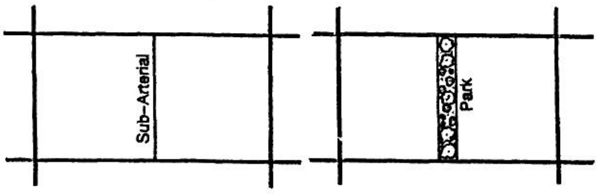


Fig. 3.2.A

In the case of an area of less than normal Neighbourhood size, it may be necessary to make special provision for residents, and especially school children, to cross a major road (desirably one with a relatively low traffic volume) to access facilities in an adjoining Neighbourhood.

3.3 THE STREET/ROAD INTERFACE

IDEALS

The points at which the Residential Streets intersect with Major Roads are the **Interface** between the two systems.

Not surprisingly then, these intersections are necessarily a compromise between the conflicting ideals of the two systems; viz:-

Road System - Controlled intersections at infrequent intervals, to maintain traffic capacity, and safety at relatively high speeds.

Street System - Intersections at frequent intervals, for driver convenience and to minimise traffic volumes on internal streets.

ROAD AUTHORITY REQUIREMENTS

Usually the criteria for the location and design of intersections to Major roads will be determined by the Road Authority, either the Council or Department of Transport (Roads Division) depending on the status of the road.

However, for situations where such criteria are not specified the following guidelines are offered.

SPACING OF INTERSECTIONS

Table 3.3.A indicates the average spacing between intersections to various Major Road categories.

Determining the acceptable number of intersections from an individual Neighbourhood to a boundary Major road is dependent on:-

- Status of the Major Road
- Length of road adjacent to the Neighbourhood
- Location and type of other existing or planned intersections

For example, for a "typical" Neighbourhood with lengths of 1350m on four sides, and no constraints from existing or planned intersections, the acceptable number of intersections could be as shown in Figure 3.3.B.

Table 3.3.A
AVERAGE INTERSECTION SPACING

	Typical Average Intersection Spacing (Metres)
2-Lane Sub-Arterial	300
Divided Sub-Arterial	300
Divided Arterial	500
Divided Major Arterial	1000

Note: **Minimum** spacings governed by geometric design requirements for the specific location.

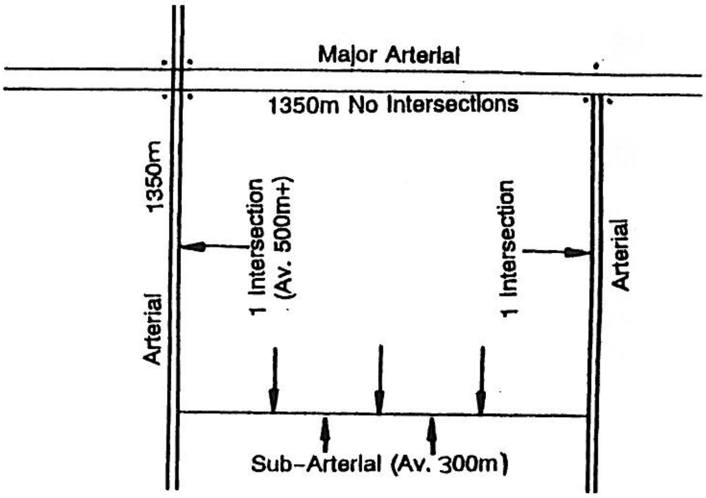


Fig. 3.3.B

TYPES OF INTERSECTION

In general the following types of intersection are appropriate between the Residential Street system and Major Roads.

- **Major Arterial**

  Generally **no** intersections.

- **Arterials**

  Generally traffic signals or roundabout, or left-in/left-out intersections (particularly appropriate where roundabouts at major intersections provide for U-turns).

- **Sub-Arterials**

  Dependent on traffic volumes, uncontrolled T-junctions acceptable, otherwise signals or roundabouts; or left-in/left-out.

Generally, full channelisation and auxiliary lanes should be provided.

DETAILED DESIGN

The detailed design of intersections should be in accordance with the following Austroads publications:-

N.A.A.S.R.A.- "Guide to Traffic Engineering Practice
- Part 5 Intersections at Grade;
- Part 6 Roundabouts;
- Part 7 Traffic Signals".

3.4 PRINCIPLES OF COLLECTOR SYSTEM DESIGN

THE COLLECTOR SYSTEM

As discussed in Section 2.9, **all** streets within the Residential area have the **Access** function as paramount and the **Traffic** function as subservient. Nevertheless, of necessity, some do have a greater traffic function than others, these being the **Collector Streets** serving a traffic catchment of 75 to 300 lots.

Within the Neighbourhood two sub-categories of street may therefore be identified, the differences being in degree rather than function:-

- **Collector System** - The "larger branches" and "trunk" connecting to the Major Road system.

- **Access System** - The "twigs" and "small branches", connecting to the Collector System.

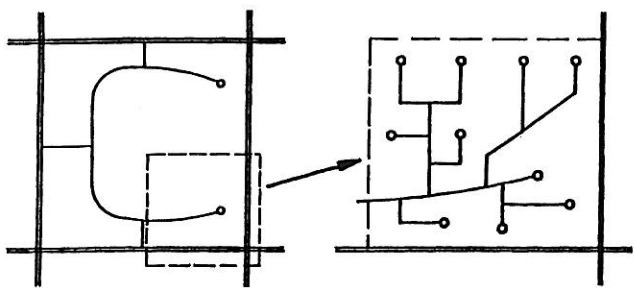


Fig. 3.4.A

DESIGN FACTORS

There are a number of factors to be considered in the design of the Collector street system, and in several cases the "ideals" of the various factors are in conflict.

Hence the final design must be a compromise, and there will very rarely be any single "right" solution, nor even general agreement on the "best" solution.

Factors to be considered include:-

- Connectivity (Internal circulation)
- Permeability to through traffic
- Legibility of layout
- Economy
- Bus Routes (see Section 3.5)

CONNECTIVITY

The degree to which the street system provides for vehicular circulation within the Neighbourhood is often referred to as "Connectivity".

A **reasonable degree** of connectivity is desirable to provide for:-

- Vehicular access from any lot within the neighbourhood to the neighbourhood facilities (e.g. school and shops) without the need to use Major roads.

- Shortest reasonable access from any lot to the Major road system:-

  - for driver convenience, by minimising travel time in a low-speed environment (desirably 60 to 90 seconds maximum, which equates to about 500 to 700m).

  - to minimise traffic volumes on the residential streets

- Alternative routes for emergency use, (e.g. accident, fire, street or service repair). Desirably, every "precinct" of more than 100 lots should have more than one possible access route, not necessarily a street but perhaps through parkland.
- Possible bus route (see Section 3.5).

However, **excessive** connectivity is undesirable, as it may:-

- Encourage through traffic to "rat run" through the neighbourhood (see "Permeability").

- Result in traffic flows in excess of the designed volumes on some streets.
- Alternatively, as assessment of traffic volumes becomes indeterminate, some streets may be overdesigned, with loss of economy (see Fig. 3.4.B).
- The street layout may become confusing to visitors (see "Legibility").

Regardless of the degree of connectivity for vehicular traffic **pedestrians and cyclists** require a high degree of connectivity, for access to neighbourhood facilities, bus routes and regional transport facilities.

However, this requirement can be provided relatively simply by pedestrian/cycle links between the ends of cul-de-sac streets and through parklands.

- By avoiding "bottle-necks" on the Major Road system, which result in unreasonable delays.
- By making any connections across the neighbourhood sufficiently circuitous to discourage through traffic.

In general, connections which provide loops accessing to the **same** major road are unlikely to cause problems. However, connections which provide for routes between major roads, either parallel or at 90^{0} to each other should be viewed with suspicion.

In assessing the likelihood of connections encouraging "rat-running" it must be borne in mind that a major signalised intersection may have 90 seconds of red time, during which time a driver can travel about **700 m** through the residential street system. Delays may be even longer if traffic does not clear the signals in one cycle.

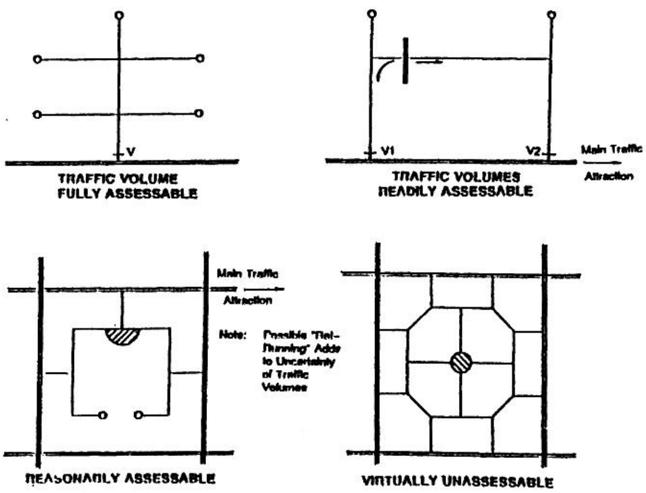


Fig. 3.4.B

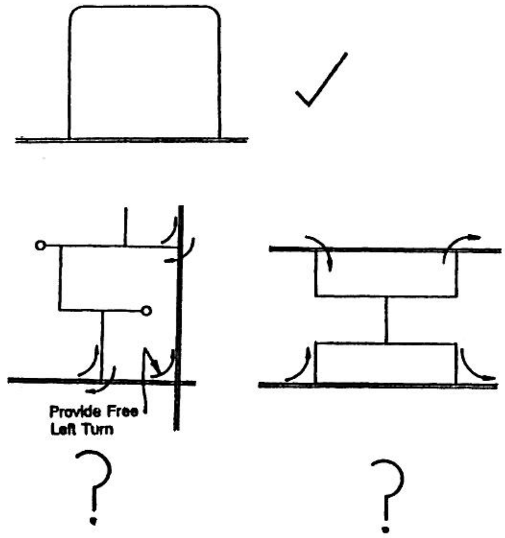


Fig. 3.4.C

PERMEABILITY TO THROUGH TRAFFIC

The whole design of the residential street system is based on the assumption that it carries only traffic with its destination or origin within the Neighbourhood, and that **through traffic is absolutely excluded.**

Any permeation of through traffic across the neighbourhood will cause excessive traffic volumes on the residential streets with consequent loss of safety and amenity to residents.

The likelihood of such "short-cutting" or "rat-running" may be minimised in two ways:-

On a system of divided arterial roads, the most likely form of "spur-of-the-moment" rat-running is across a left turn intersection, to avoid long signal delay. Provision of a free left turn lane will reduce this tendency. However, premeditated right-turn rat-running by regular travellers may be a greater problem.

The situation can be **minimised** by identifying the most likely rat-running movements in the morning and evening peaks, and keeping connections through the Neighbourhood generally at right-angles rather than parallel to the main traffic movements. Possible future traffic generators should also be considered when assessing main traffic movements.

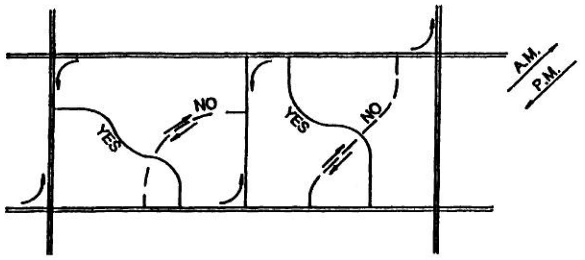


Fig. 3.4.D

Off-setting intersections of residential streets to arterials, rather than using 4-way signalised intersections or roundabouts, will also assist in discouraging through traffic from using residential streets as alternative routes parallel to congested arterials.

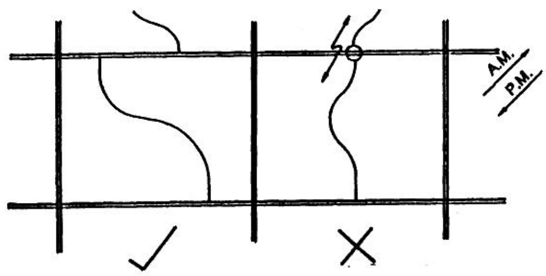


Fig. 3.4.E

LEGIBILITY

"Legibility" refers to the ease with which the street layout can be "read" by street users, particularly visitors.

With regard to the main "framework" of the neighbourhood streets, the emphasis should be on simplicity of layout, with a minimum of alternative routes, and a minimum number of turns to be made to reach a destination.

Legibility may also be assisted by consistent treatment of intersections and speed control devices, to define the major route, e.g. block paving of minor street approaches.

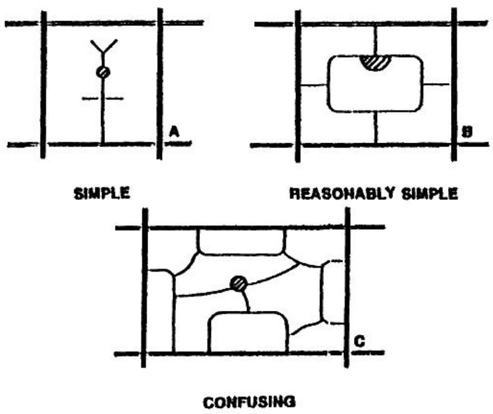


Fig. 3.4.F

ECONOMY

Economy of construction is achieved when:-

- The length of street within the neighbourhood to which residential frontage is denied (i.e. over 3000 v.p.d. traffic volume) is minimised. The "ideal" is obviously that there be no such streets; and
- No street is designed in excess of its required capacity. This implies a layout in which the traffic volume in every street can be reasonably assessed.

3.5 BUS ROUTES

RELEVANCE

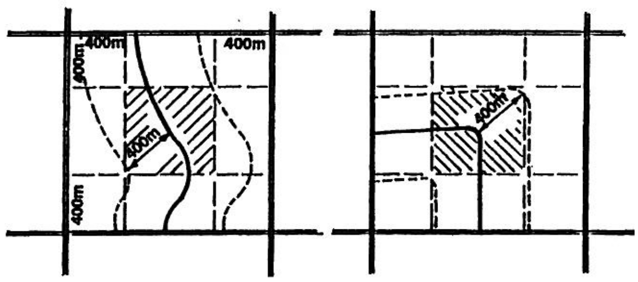
The relative importance of provision for bus-routes must be assessed for the area under consideration, in the light of the likelihood of a bus service being provided. In areas where a bus service is existing, or may reasonably be expected to be provided in the future, the neighbourhood design should make appropriate provision for suitable future routes.

DISTANCE TO BUS ROUTE

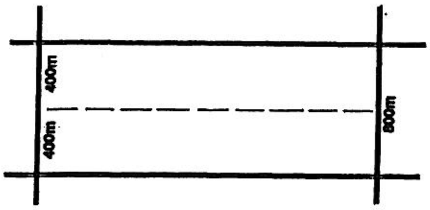
A commonly quoted "ideal" for the provision of bus transport is that each residence be within 500m walking distance of a bus-stop.

This may be converted to a Guideline that **90% of allotments be within** a **400m** straight-line distance **of a potential bus route.**

Effectively, this means that for most Neighbourhoods a single potential bus route should be provided across the neighbourhood.



Bus route required to serve shaded area.



No bus route required.

Selection of an appropriate route through an individual Neighbourhood requires consideration of routes in the surrounding area. If a "bus route strategy plan" is available, or there are existing services, these would provide a starting point. A logical strategy may provide for Express buses on the Major Roads, with a local service traversing the neighbourhoods.

BUS ROUTE REQUIREMENTS

Detailed Bus Route Requirements within the Neighbourhood are:-

- Desirably should be located only on Trunk Collector Streets
- Reasonably direct
- No "doubling back" (unless at the terminus of a route)
- Minimum travel distance in low-speed streets (from consideration of both the buses and residents).

Bus routes should **not** be located on streets of lesser classification than **Collector**. Such a street can accommodate the occasional local bus on its 7.5m carriageway, at the reduced speed appropriate to a residential street. Widening the carriageway, to increase convenience for a possible future bus service, would be inconsistent with residential street philosophy.

However, where potential bus routes are identified, provision should be made in the detailed design for sufficient verge width to accommodate possible indented bus-bays and passenger shelters at likely major bus stops.

"Bus-Only" links are sometimes proposed, to provide direct bus connections but inhibit through traffic. However enforcement by regulation is unlikely to be effective and physical constraints are likely to be hazardous to other vehicles.

3.6 NEIGHBOURHOOD SCHEMATIC LAYOUT

APPLICATION OF DESIGN PRINCIPLES

The Design Principles discussed in Section 3.4 may be applied to a theoretical neighbourhood to investigate and evaluate the possible range of Schematic Layouts.

RESIDENTIAL "CELLS"

The requirement that the maximum traffic volume in any residential street be an absolute maximum of 3000 v.p.d., and desirably a maximum of 2000 v.p.d., tends to result in a layout consisting of a series of "cells" or "precincts" each of 200 to 300 lots (see Section 2.2), with a single major connection to the street or road system external to the "cell". The provision of connections to adjoining cells may tend to blur the boundaries between cells in the final layout, but the "Cell Concept" provides a useful building block for schematic design.

A typical Neighbourhood of 1800 allotments will then be made up of **6 to 9 cells each of 200 to 300 lots.**

SOME SCHEMATIC OPTIONS

Figures 3.6.A to F show a range of possible schematic layouts, together with a summary of their respective advantages and disadvantages.

From these examples, three (3) basic forms of schematic layout can be identified:-

- Connection of Individual "cells" direct to Major Roads - (Options 1 and 3);
- Interconnection between Cells, using Collector Streets - (Options 2 and 4);
- No Access Internal Street, providing connection between Cells and to the Major Road System - (Options 5 and 6).

Each has its advantages and disadvantages, resulting mainly from the varying compromises between the factors of:-

- Permeability
- Connectivity
- Economy.

SOME SCHEMATIC OPTIONS

OPTION 1

Individual Connection from each Cell to Arterial Roads - No Interconnection

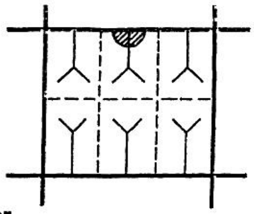


FIG 3.6A

Each cell - 300 lots
Each access - 3000 v.p.d.

For
- Impermeable to through traffic
- No uncertainty of internal traffic volumes
- No "No-access" streets required
- Minimum travel time in low-speed streets

Against
-Lack of internal connection
-Need to use arterial roads to access facilities
-No sense of "Neighbourhood"
-No alternative routes
-No practical bus route
-Large number of intersections to arterial roads.

OPTION 2

Individual Connections from each Cell to Arterial Roads, but Interconnection between cells

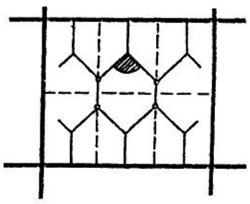


Fig 3.6B

Each cell - 300 lots
Each access - 2100 v.p.d. ±

For
- Internal connections to access facilities
- Alternative routes available
- Minimum travel time in low-speed streets
- Sense of "Neighbourhood"
- Bus route possible
- Bus route all in low-speed streets.

Against
-Uncertainty of internal traffic volumes - may likely exceed 3000 v.p.d.
-Permeability to through traffic
-Large number of intersections to arterial roads

OPTION 3

Combined Connections to Arterial Roads - No internal connection

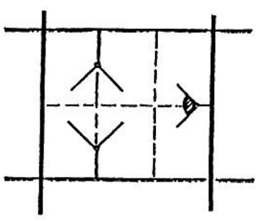


Fig 3.6C

Each cell - 300 lots
Each access - 6000 v.p.d.

For
- Impermeable to through traffic
- No uncertainty of internal traffic volumes
- Number of intersections to arterials minimised

Against
-Lack of internal connection
-Use arterials to access facilities
-No sense of "Neighbourhood"
-No alternative routes
-No practical bus route
-"No-Access Streets" required (but minimum length)

OPTION 4

Combined connections to Arterial Roads with Internal Connection between Cells

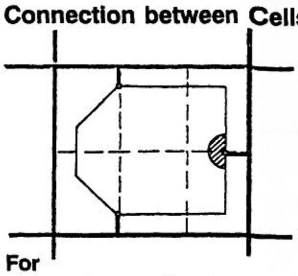


Fig 3.6D

Each cell - 300 lots
Each access - 4200 v.p.d. ±

For
- Internal connections to access facilities
- Alternative routes available
- Sense of "Neighbourhood"
- Bus route possible
- Minimum intersections to arterials

Against
-Uncertainty of internal traffic volumes - likely to exceed 3000 v.p.d.
-Permeability to through traffic
-"No-access" streets required (but minimum length)

OPTION 5

No-Access Internal Street to Connect to all Cells - Dead end

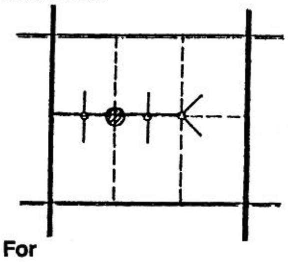


Fig 3.6E

Each cell - 300 lots
Each access - 12,600 v.p.d.

For
- Internal connection to access facilities
- Impermeable to through traffic
- Minimum intersection to arterial roads
- No uncertainty of traffic volumes
- Sense of "Neighbourhood"

Against
-Considerable length of "no-access" road
-No alternative routes
-No provision for bus route (unless route terminates)
-Longer travel times

OPTION 6

No-Access Internal Street to Connect all Cells - Through Street

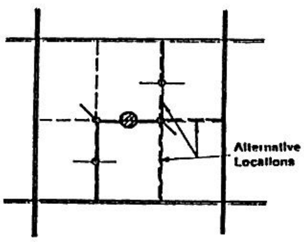


Fig 3.6F

Each cell - 300 lots
Each access - 6,300 v.p.d. ±

For
- Internal connection to access facilities
- No uncertainty of traffic volume on residential streets
- Alternative routes available
- Bus route available
- Sense of "Neighbourhood"

Against
-Maximum length of "no-access" road
-Some permeability to through traffic
-Some uncertainty of traffic volume on through road
-Through road may be "divisive".

3.7 THE "NO-ACCESS STREET"

NEED FOR A "NO-ACCESS STREET"

From consideration of possible schematic neighbourhood layouts it is evident that it will not always be possible to maintain the traffic volume on Collector Streets below 3000 v.p.d.

Whenever the number of accesses to the major road system is less than the number of "cells", and whenever there is connectivity provided between cells, there is the possibility of sections of the Collector Street system carrying volumes **in excess of 3000 v.p.d.**

By definition, such a street cannot provide direct frontage access to Residential lots, due to the loss of amenity resultant from such traffic volume; hence the term "No-Access Street".

NOMENCLATURE

A common terminology for such a street is a "No-Access Distributor", while AMCORD applies the name "Trunk Collector" to the particular case of a street of this type 150m or less in length. As a compromise these Guidelines propose that the term **"Trunk Collector"** be used, regardless of the street length.
It may be argued whether "Street" or "Road" is the appropriate term for this thoroughfare, as it is rather ambivalent by nature, being within the residential area yet not providing direct access to residential lots. However, the term **"Street"** is considered more applicable as:-

- It is within the residential Neighbourhood;
- Design philosophy is to **restrict** speed, by geometric design, as for other residential streets (see Section 2.3).

CALCULATION OF TRAFFIC VOLUME

The methods of Section 2.2 can be expanded to calculate the probable traffic volume on each section of Trunk Collector Street.

The traffic capacity of such a street, with no frontage access or parking, is considerable, but having regard to speed restrictive design, and the residential environment, the maximum traffic volume should be limited to **10,000 v.p.d.**

ECONOMY

As the lack of facility to access residential lots directly to this type of street can impose a certain economic penalty on subdivision development, the subdivision layout should keep the length of such streets to a reasonable minimum.

Judicious variations of the Collector layout can minimise the extent of "No-Access" streets required by reducing the traffic volume on critical sections of the Collector streets e.g.:-

- Relocation of intersections to Arterials;
- Relocation of cell connections to Collectors;
- Omission or insertion of some connections;
- Detailed design to encourage or discourage use of appropriate routes.

Maximum use of the street for access to uses other than single residential lots will also assist economy.

The side boundaries of residential lots may also adjoin the street, subject to the provision of adequate noise and visual buffer strips, and prevention of vehicular access.

ACCESS

While the Trunk Collector provides no direct frontage access for residential lots, it may provide access for Multi-unit residential development, Schools or Shopping Centres, provided that:-

- Provision is made for internal turning of vehicles and hence ingress and egress are in a forward direction only.
- The accesses are provided with auxiliary lanes and channelisation as necessary
- Appropriate buffer strips are provided.

STANDARDS

Typically, design standards appropriate for Trunk Collector Streets are:-

Design Speed

Design geometry to limit vehicle spot speeds to **60 km/h**, in accordance with the provisions of Section 2.3.

60 km/h is considered appropriate for traffic capacity and travel time requirements, and in consideration of there being no direct frontage access. However, **speed limiting** design is also considered appropriate as the street is **within** a residential area, and hence will carry internal vehicular traffic, pedestrians and cyclists within the reserve width.

Traffic Volume

10,000 v.p.d. maximum

Carriageway

Travel lanes - 2 x 3.5m
Provision for additional auxiliary lanes and possible future bus bays.

Drainage

Standard "Layback" type concrete kerb and channel will generally be the more appropriate edge treatment, to be consistent with other streets within the neighbourhood, and as there will be frequent intersections and/or accesses. However, grassed swale drains may be an acceptable alternative.

Cross-Section

See Figure 3.7.A for a "Deemed-to-Comply" cross-section.

A further alternative is **a divided carriageway with a median,** particularly appropriate where there is a succession of channelised intersections and/or accesses. A median of 2.0m minimum width also greatly assists pedestrian crossing opportunity.

Each carriageway should be 5.0m width, to provide for passing a disabled vehicle.

Reserve Width

20 - 30m (dependent on selected drainage system, and intersection geometry-see Figure 3.7.A).

Parking

No provision -
Design to discourage on-road parking e.g. adequate on-site parking for adjacent development, and landscape or fence barriers between road and development.

Intersections

Arterial or Sub-Arterial
- Signalised, roundabout or "T" (all movements or left in/left out)

Other Trunk Collector, Residential Collector, Access Street or Access Place
- "T" or roundabout

Minimum Spacing - 100m.

All intersections and major development accesses (e.g. schools, shopping centres, multi-unit developments) to be provided with Right turn, deceleration, and passing lanes, 3.0m wide. Channelisation at intersections and accesses is generally necessary.

Bus Bays

Sufficient width for indented bus bays at appropriate locations (e.g. schools, shopping centres, major intersections, pedestrian routes).

Pedestrians and Cyclists

Provision dependent on overall planning, but generally Dual-Use pedestrian/cyclist paths in the verge on one or both sides, or provision for pedestrians and/or cyclists on alternative route locations.

Services

Verge width sufficient for possible major services required.

Aesthetics

- Mounding and landscaping to be provided
- Uniform fencing erected by the developer is desirable.

3.8 PRACTICAL COLLECTOR SYSTEM DESIGN

FACTORS

Application of the Schematic Layout theory to practical situations requires consideration of the following site - specific factors:-

- Intersections to Major Road system
- Type and location of Neighbourhood facilities
- Topography
- External traffic attractions - (work opportunities, retail, other)
- External bus routes
- Open Space corridors

INTERSECTIONS

The opportunities and limitations for the location of intersections to the boundary major road system have been discussed in Section 3.3.

Points to consider in selection of intersection locations include:-

- The maximum number of intersections will reduce traffic volumes and travel distance on Collector Streets;

- The risk of permeability ("rat-running") also tends to increase with the number of intersections.

NEIGHBOURHOOD FACILITIES

The type and location of neighbourhood facilities are determined more by Planning than Engineering criteria. However, the only traffic-generating facilities likely to be provided within the neighbourhood are:-

- Neighbourhood shopping centre
- Primary school
- Child Care Centre

To provide a Neighbourhood "nucleus", a reasonable arrangement could be to have the school linked by a neighbourhood park to the shopping centre and child care centre.

Both the shopping centre and the school are generally intended to serve only the subject neighbourhood, and hence should be located for maximum accessibility from all parts of the neighbourhood.

A logical location for the facilities is on a major access into the neighbourhood, for convenience of residents entering and leaving the neighbourhood, but not so close to a major road as to attract traffic to the shopping centre from the major road system.

However, there will inevitably be some traffic to these facilities from outside the neighbourhood (e.g. shop employees, deliveries, school teachers) and the probable "Trunk Collector Street" between the major road and the neighbourhood facilities will provide for such traffic.

TOPOGRAPHY

While the detailed street design must necessarily take due account of topography, the schematic or concept design must also have regard to major topographic constraints, such as:-

- Steep land (too steep for acceptable street grades)
- Flood prone land (unsuitable for residential use)
- Major watercourses (minimising crossings)

EXTERNAL TRAFFIC ATTRACTIONS

Assessment of traffic volumes on the internal Collector Street system requires a judgement on the location of both present and likely future major external traffic attractions, in order to infer the likely travel routes on the internal streets.

The directions of the major morning and evening peak flows on the major road system, resultant from traffic to and from these major traffic attractions, is also significant, to judge likely "rat-running" tendencies.

BUS ROUTES

The location of existing, planned or likely future bus routes in the vicinity of the neighbourhood will assist in assessing the location for a practical potential bus route through the neighbourhood.

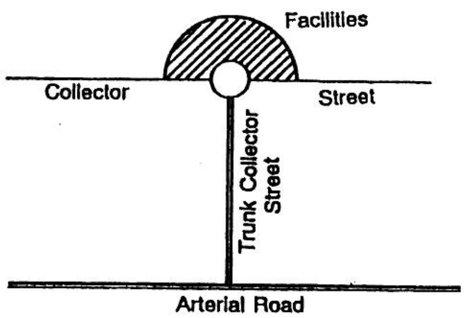


Fig. 3.8.A

3.9 THE ACCESS STREET SYSTEM

DESCRIPTION

The Access Street System refers to the whole of the street system within the Neighbourhood other than the system of Trunk Collector and Collector Streets which provide the connection between each street cell and the Major Road system (see Section 3.4).

Typically, the Access Street System will be made up of a number of virtually self-contained "cells", each with a single Collector Street "stem", connecting with either the Neighbourhood Collector System or the Major Road System, and in turn branching into a number of Access Streets and Access Places.

However, interconnection between branches may create a number of "loops", tending to blur the basic "branch" layout.

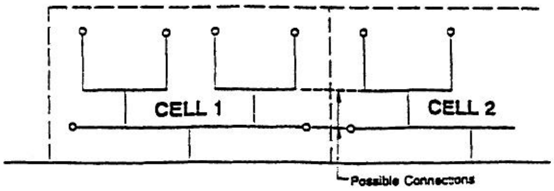


Fig. 3.9.A

Layouts may be categorised by the number of branch systems, or the number of turns necessary by a driver to reach the furthermost street, e.g.:-

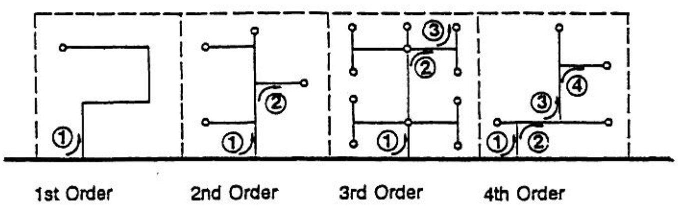


Fig. 3.9.B

FACTORS

The design of Access Street layouts should recognise the following factors:-

- Connectivity
- Permeability
- Legibility
- Traffic volume minimisation
- Travel time minimisation.

The first three are identical to Collector System considerations, however for the Access System the emphasis is slightly different.

CONNECTIVITY AND PERMEABILITY

These two factors are inter-related:-
- Without Connectivity there is no Permeability.
- Connectivity **may** result in Permeability.

The basic "branching" street layout should be designed to provide the most reasonably direct route for the majority of traffic movements. Assuming that this is the case, the only justification for additional connectivity is to provide alternative routes for emergency use.

A reasonable criterion for such connections is that any group of lots larger than perhaps 100 should not be completely isolated by the blockage of any single street.

Excessive connectivity is undesirable as:-

- The "Cell" may become permeable to through traffic from other cells, resulting in excessive traffic volumes;
- Assessment of traffic volumes becomes indeterminate due to the number of alternate routes, resulting in either over or underdesign;
- The layout may become confusing to visitors.

Where additional connections are provided, they should be approximately at 90 degrees to the main traffic direction to avoid inadvertently creating alternative parallel routes to the Collector Street system.

As discussed in Section 3.4, regardless of the degree of connectivity for vehicular traffic **pedestrians and cyclists** require a high degree of connectivity, for access to neighbourhood facilities, bus routes and regional transport facilities, but this requirement can be provided relatively simply by pedestrian/cycle links between the ends of cul-de-sac streets and through parklands.

LEGIBILITY

Taken to extremes a "Multi-branching" layout can be confusing to street users, particularly visitors. Hence to keep the layout "legible", or easily read, layout should not generally exceed **"Third Order"**, i.e. a driver should not have to make more than three turns, or utilise more than three different streets between the neighbourhood Collector Street system and his destination.

A large number of alternative routes can also be confusing, another reason for limiting connectivity.

MINIMISING TRAFFIC VOLUME

While the maximum traffic volume in the street system is limited, it is also highly desirable that the **greatest possible percentage of allotments has the least possible volume of passing traffic.** This can be achieved by having as many lots as possible located in short streets.

Figure 3.9.C illustrates the various cases of a "First Order" single cul-de-sac of 300 lots (theoretically possible, but not really practical), and multi-order layouts with the majority of lots in cul-de-sac streets of 75 lots and 30 lots respectively. A desirable criterion is that 90% of allotments should have a passing traffic volume of less than 1000 vehicles per day.

Hence, other things being equal, a multi-order layout with a large number of very short cul-de-sac streets is preferred.

TRAVEL TIME

For the convenience of all street users the distance from each allotment to the major road system should be a reasonable minimum.

Pedestrian and cyclists may be provided with convenient "short cuts" via pathways or park areas.

For vehicles the most significant factor is the travel **time**, as drivers may become impatient with the slow-speed environment if the time is excessive.

For comparison, indicative travel times for a 300 lot catchment could be:

1st order layout	-	250 secs
2nd order layout	-	70 secs
3rd order layout	-	60 secs

60 seconds is generally considered a reasonable travel time, with 90 seconds as a maximum. Hence either **Second or Third** order layouts are generally acceptable.

PREFERRED LAYOUT

From the above considerations of Legibility, minimising Traffic volumes, and minimising Travel time, **Second or Third order layouts** are generally the preferred basis for design.

THE STREET SYSTEM

OBJECTIVES

- To provide acceptable levels of access, safety and convenience for all street users in residential areas, while ensuring acceptable levels of amenity, and protection from the impact of traffic;
  (AMCORD 01, page 46)
- To provide a network of streets with clear physical distinctions between each type of street, based on function, legibility, convenience, traffic volumes, vehicle speeds, public safety and amenity;
  (AMCORD 03, page 46)
- To avoid streets within any residential neighbourhood from operating as through traffic routes for externally-generated traffic;
  (AMCORD 010, page 46)
- To control the maximum length of time travelled in a low speed environment;
  (AMCORD 09, page 46)
- To provide for the safe and convenient movement of pedestrians and cyclists throughout the development;
  (AMCORD 06, page 46)
- To provide for bus routes which are both accessible from all dwellings and activity centres, and efficient to operate;
  (AMCORD 04, page 46)
- To establish a street and pedestrian network which provides convenient linkages to activity centres;
  (AMCORD 011, page 46)
- To provide the basis for cost-effective design and construction of the street network.
  (AMCORD 012, page 46)

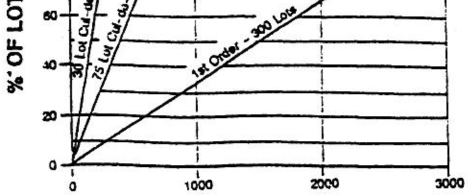


Fig. 3.9.C

PERFORMANCE CRITERIA

- The internal street layout to conform to the requirements of the external arterial road network and satisfy the transport provisions of an outline or concept development plan which conforms to the principles of this Model Code.
  (AMCORD P3, page 4)
- The design features of each type of residential street to convey its primary functions and encourage appropriate driver behaviour.
  (AMCORD P4, page 48)
- Streets to link with other streets that are no more than two levels higher or lower in the hierarchy.
  (AMCORD P5, page 48 modified)
- Connections between residential streets to be T-junctions or controlled by roundabouts.
  (AMCORD P6, page 48)
- Where access streets or places form part of a pedestrian or cycle network, access links should provide suitable connections to adjoining access streets or open space systems so that the pedestrian and cycle networks are functional, cost-effective and have visual supervision.
  (AMCORD P7, page 48)
- The street and road network to provide for bus routes within acceptable walking distance from all dwellings.
  (AMCORD P8, page 48)
- Neighbourhood areas which can each support its own primary school and shopping facilities.
- Minimum number of intersections to the Major Road system.
- Street layout to minimise travel time and traffic volumes on neighbourhood streets.
- Street layout providing a reasonable degree of internal connectivity.
- Low permeability of street layout, to positively discourage through traffic.
- Street layout to be "legible".
- Traffic volume on all streets to be reasonably assessable.
- Street layout to provide maximum economy of construction.

ACCEPTABLE SOLUTIONS

- Neighbourhood areas within the range of 1200 to 1800 allotments.
- Intersection spacing of Neighbourhood Streets to Major Roads in accordance with Table 3.3.A.
- Design of intersections to Major Roads in accordance with Road Authority and/or NAASRA (Austroads) standards.
- Maximum travel time of 90 seconds on low-speed streets (i.e. less than 60km/h design speed)
- Maximum traffic volume of 3000 v.p.d. on any street with direct residential access.
- 90% of lots with a frontage traffic volume of less than 1000 v.p.d.
- All lots with vehicular access to neighbourhood facilities without need to use Major Roads.
- Street layout not exceeding "3rd Order" - i.e. no lot requiring more than three turns, or use of more than three streets, from the neighbourhood Collector Street system.
- All "precincts" of more than 100 lots having an alternative street access.
- Potential bus route located within 400m of 90% of allotments.
- Minimum possible length of Trunk Collector Streets.
- Design of Trunk Collector Streets in accordance with Section 3.7.
- Design of all other streets in accordance with Section 2.0.

SECTION 4.0 - PEDESTRIANS AND CYCLISTS

QUEENSLAND STREETS

4.1 GENERAL

The provision of **safe and convenient** facilities for pedestrians and cyclists is of at least equal importance to providing for the requirements of motor vehicles. In residential streets it is the primary consideration.

Pedestrian and cyclist facilities are both:-

Essential
for those who do not have a motor vehicle, or choose not to use it, e.g. school children, the elderly, shoppers and commuters connecting to bus routes or railway stations.

Highly Desirable
to encourage residents to walk or cycle, for healthy recreation or as an alternative to the motor vehicle, with resultant reductions in traffic volume, parking demand, fuel consumption, and noise and air pollution.

4.2 PLANNING

PLANNING PROCESS

The planning of these facilities must be an integral part of the design of the total urban system, and not merely an afterthought.

The Planning Process consists of the following steps:-

- **Identification** of pedestrian and cyclist destinations, e.g. schools, shopping centres, sports and recreation facilities, bus stops, railway stations, etc.
- **Strategic Design** - Selection of the general location of major pedestrian and cycle routes linking each residential precinct to these destinations by the most favourable routes.
- **Detailed Design** - As an integral part of the overall development design, providing for:-
  - **Major Routes** as identified in the Strategic Design
  - **Minor Connections**, to provide for interconnection between precincts, and connections within each precinct, to provide maximum convenience of access from each allotment to the major system, e.g. connections between cul-de-sac heads, or from streets to the public open space system.

ROUTE LOCATION

The route selection objectives of pedestrians and cyclists are neither identical with each other nor with those of motorists.

Distance - is vitally important to pedestrians;
- slightly less important to cyclists; and
- less important again to motorists.

Gradient - is vitally important to cyclists;
- slightly less important to pedestrians, and
- less important to motorists.

Given alternative routes **pedestrians** will opt for the **shortest**, except where only a slight extra length results in a marked reduction in grade, whereas **cyclists** may prefer a rather longer route if the grade reduction is noticeable.

The choice will be made **regardless** of the designer's intentions,

For example, both pedestrians and cyclists will use major roads rather than special purpose pathways if the roads are more advantageous in length and grade, and cyclists **will** use pathways intended for pedestrians if the location is attractive to them.

Hence, to ensure they are used as intended, pedestrian and cycle routes **must provide a more attractive route than any available alternative.**

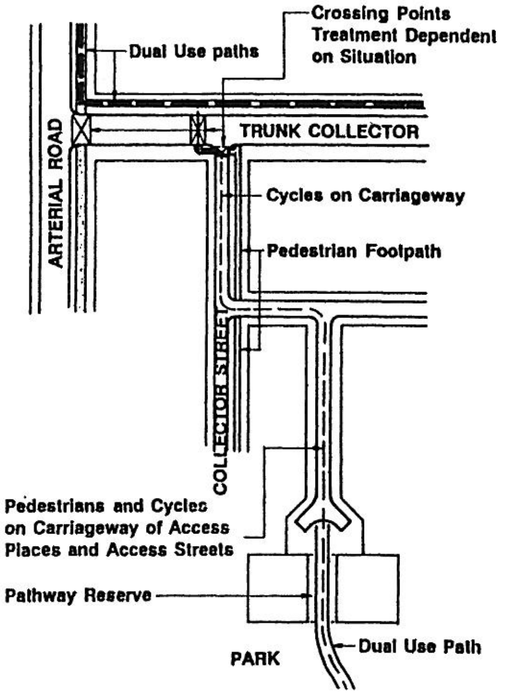
SYSTEM COMPONENTS

The components of a pedestrian or cyclist system may include:-

- Carriageways of minor streets.
- Paths on the verge of roads and streets with higher traffic volumes.
- Paths in separate reserves.
- Paths through areas of public open space.

Paths may be intended for:-
- Pedestrians only (Footpaths)
- Cyclists only (Cyclepaths)
- Both Pedestrians and Cyclists (Dual-use paths)

The most economic location is within residential streets, where provision may be made for both pedestrians and cyclists at little or no extra cost. The location of major routes should therefore make maximum use of residential streets in the interests of overall economy.



PEDESTRIAN & CYCLIST SYSTEM TYPICAL COMPONENTS

Fig. 4.2.A

4.3 RESIDENTIAL PRECINCTS

One of the major reasons for designing for minimum traffic speed and volume in residential streets is to provide safe and comfortable conditions for pedestrians and cyclists, and within street systems designed to the specified standards (i.e. 2000 to 3000 vpd maximum volume and 30 to 40 km/h maximum speed) pedestrians, cyclists and motor vehicles can reasonably co-exist, subject to appropriate provisions.

Hence, **every Residential Street is a Pedestrian and Cycle route.**

ACCESS PLACES AND ACCESS STREETS

No special provision is generally required, as the low traffic volume and speed in these streets enable both pedestrians and cyclists to safely share the carriage-way with motor vehicles. However, on Access Streets the verge cross-section should allow for future construction of a footpath if required.

COLLECTOR STREETS

The higher traffic volume and speed on Collector Streets necessitates provision of a constructed pedestrian footpath within the verge, generally on one side only. No special provision is normally required for cyclists.

TRUNK COLLECTOR STREETS

Where pedestrian or cycle routes are located on Trunk Collector Streets, the still higher volume and speed of traffic on these streets requires special provision for both pedestrians and cyclists:-

Pedestrians - Constructed footpath within the verge, on one or both sides;

Cyclists - Cycle paths or Dual-Use paths within the verge on one or both sides.

PARTICULAR CASES

In some circumstances additional provision may be required for pedestrians and cyclists:-

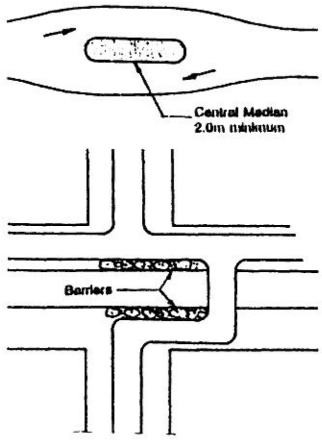
- **Designated Pedestrian or Cycle Routes**
  Where a residential street forms part of an area-wide system, and pedestrian or cycle traffic-volumes may be significant, (e.g. approaching a school) a footpath for pedestrians, or a designated cycle lane on the carriageway may be warranted.

- **Crossing Points**
  On **Access and Collector Streets** no special provision is usually required for pedestrian or cyclist crossing, due to the low speed environment already existing in these streets.

  On **Trunk Collector Streets**, a median of 2.0m minimum width within the carriageway will greatly assist safe crossing of the street. Where major pedestrian or cycle routes must cross a Trunk Collector Street, it may be desirable to create a lower speed environment by appropriate geometry or devices on either side of the crossing location.

  Crossing points should not be **combined** with Slow Points or other traffic control devices, however, due to the resultant dividing of a driver's attention.

  Where Pathways (pedestrian, cycle or dual-use) intersect with streets, physical barriers to prevent pedestrians or cyclists from directly crossing the street will assist safe crossing.



Crossing Points
Fig. 4.3.A

- **Turning Provision**
  Where there is a high incidence of right turning cycle traffic, e.g. approaching a school, or at a turn of a designated Cycle Route, a median island may provide shelter for turning cyclists.

4.4 MAJOR ROAD SYSTEM

The compatibility of pedestrians and cyclists with motor vehicles, which exists within the Residential Street system, does **not** extend to the Major Road system, where the higher volume and speed of vehicular traffic results in much greater risk for the pedestrian and cyclist.

Where pedestrian and cycle routes follow Major Roads, separate off-carriageway paths must be provided.

The grade and travel distance of these paths must be no greater than that of the vehicular carriageway, or pedestrians and cyclists will tend to use the carriageway in preference to the path.

In general, provision must be made for both pedestrians and cyclists, either by separate paths or dual-use paths. If paths intended only for pedestrians are provided, **cyclists will inevitably use them anyway.**

DUAL-USE PATHS

For this reason **dual-use paths** are probably the most practical and economic, even though there is some potential for conflict between pedestrians and cyclists.

CROSSINGS OF MAJOR ROADS

Crossings of pedestrian and cycle ways across major roads must be carefully designed for safety and convenience.

Grade separation by underpass or overpass is the ideal, but generally only economically justifiable for Major Arterial roads.

For at-grade crossing of Arterial or Sub-Arterial roads:

- **The crossing should be:-**
  - Staged, with a central refuge island, for lower volume roads, or
  - Signal controlled for higher volumes, desirably by location at a signal controlled intersection.
- Physical barriers should be provided, to require cyclists to dismount, and to prevent pedestrians crossing directly.

However, the form of crossing to be provided should be discussed in advance with the Road Authority.

4.5 SEPARATE RESERVES

PATHWAYS

Pedestrian and cycle routes may be located in a separate reserve ("pathway"). Typically, these will be relatively short, providing connection between the ends of cul-de-sac streets, from streets to open space areas, or from residential streets to major roads.

Such connections are essential to minimise pedestrian and cyclist travel distances, rather than having to follow the longer distances via the street system, where connectivity must be limited to prevent through traffic infiltration.

Pathways should be sufficiently wide (6.0 m desirable minimum), well-lit, and intervisible full length, to avoid an "alleyway" effect.

In general, they should be designed as dual-purpose pedestrian and cycle routes for practical and economic considerations.

Pathway reserves may serve additional purposes, such as a location for stormwater drain lines, connecting watermains or other services, or as overland stormwater flow paths. However in the latter case care must be taken to ensure that the maximum depth and velocity of flow will not be a hazard to users.

PATHS THROUGH OPEN SPACE

Public open space areas can provide ideal locations for Pedestrian and Cycle paths, providing safety from vehicular traffic, and high environmental quality for pleasant travel.

Again, lighting and visibility are very important for the security of users.

These paths also should in general be designed for dual pedestrian and cyclist use.

4.6 CONSTRUCTION IN RESIDENTIAL STREETS

It is impractical to construct footpath paving in residential streets until at least most of the dwellings have been completed due to the inevitable damage to the paving from heavy building traffic.

In the case of vacant land subdivision it is therefore preferable to defer paving construction, with the Local Authority requiring either a bond or cash contribution to cover future construction when appropriate.

4.7 PHYSICAL DESIGN STANDARDS

Appropriate design standards for pedestrian and cycle paths are detailed in Section 4.8.

A useful reference for the detailed design of Cycle Routes is:

Bicycle Facilities - Design Guidelines
Bikewest 1988
Department of Local Government, Western Australia.

PEDESTRIANS AND CYCLISTS

OBJECTIVE

- To provide for the safe and convenient movement of pedestrians and cyclists throughout the development;
  (AMCORD 06, page 46)

PERFORMANCE CRITERIA

- A network of pedestrian ways and cycle ways to be in acordance with any approved plan which has been prepared having considered:
  - projected travel demand;
  - opportunities to link open space networks, community facilities and public services; and
  - environment, location, safety and weather factors.

  (AMCORD P1, page 72)
- Design of street network to accomodate pedestrian and cyclist use of street pavements in access places and access streets;
  (AMCORD P2, page 72)
- Design of access places, access streets and collector streets to accomodate cyclist use of street pavements.
  (AMCORD P3, page 72)
- Where shared use of street pavement is not appropriate, provision to be made for the construction of a non-skid durable path of sufficient width and strength for:
  - use by pedestrians;
  - use by cyclists where warranted.

  (AMCORD P4, page 72)
- Design to facilitate ease of use by the disabled and aged.
  (AMCORD P5, page 72)
- Maximum longitudinal gradient of cycle paths to be no greater than any adjacent street pavement and to provide for safe sight distances at crossings.
  (AMCORD P6, page 72).
- Alignment of paths to be varied to preserve trees and other significant features and to add to visual interest.
  (AMCORD P7, page 72)

- Widening of paths to be provided at conflict points on high use facilities to allow for passing of pedestrians/cyclists in opposits directions. **(AMCORD P8, page 72)**

- Crossing of pedestrian and cycle paths across major roads to be minimised, and where crossings are necessary to be carefully designed.

ACCEPTABLE SOLUTIONS

- Design and construction of pedestrian and cycle routes in accordance with Section 4.0.

- Unless otherwise required by the provisions of Section 4.0:-

- Access Streets & Places	-	No specific construction.
- Collector Streets	-	Pedestrian footpath or Dual-use path on one side.
- Trunk Collector Streets	-	Pedestrian footpath one side or both sides (where part of a Pedestrian or Cycle Route)
	-	Dual-use path one or both sides.
- Major Roads (where part of a Pedestrian or Cycle Route)	-	Dual-use path one or both sides.

- Design and construction standards as follows:

		FOOTPATH	CYCLE PATH OR DUAL USE PATH
Path Width		1.2m	2.0m
Formation Width (Separate path)		2.0m	3.0m
Cycle Lane Width		-	1.5m
Crossfall	- min	1:40	1:40
	- max	1:20	1:20
Clearance	- Horizontal	2.0m	2.5m
	- Vertical	2.0m	2.5m
Grade	- Desirable max.	8.0%	1.5%
	- Absolute max.	12.5%	2% for 450m max. 5% for 90m max. 10% for 30m max.
Curve Radius - min.		-	5m-15m (Dependent on grade)

Materials - Concrete, asphaltic concrete, or block paving (concrete or brick)

Signing - Both footpaths and cyclepaths adequately signed as to destination and use. Cyclepaths and Dual-use paths signed in accordance with AS 1742.9-1986.

Lighting and Visibility - Both footpaths and cyclepaths adequately lit at night and providing good visibility.

SECTION 5.0 - DESIGN DETAIL

QUEENSLAND STREETS

5.1 KERB & CHANNEL

ALTERNATIVES

The two general alternative forms of providing drainage of the street are:-

- Kerb and channel
- Grassed swale drains

RESIDENTIAL STREETS

The use of kerb and channel is considered preferable where there is direct frontage of residential allotments to the street, for the following reasons:-

- No pondage of water, as may occur with swales, with resultant resident complaint;
- More positive drainage of the verge reduces risk of damage from vehicles occasionally parking on the verge;
- Provides protection for the pavement edge, against damage from vehicles;
- Reduces casual encroachment of vehicles onto the verge;
- Obviates the need for potentially unsightly and dangerous entrance culverts to properties;
- Reduces the total required verge width;
- Encourages mowing of the verge by residents by reducing boggy spots, and loose gravel on pavement edge.
- Provides for discharge of roofwater drainage to the street.

MAJOR ROADS AND STREETS

Where there is no frontage of lots to the street, such as on Trunk Collector Streets or Arterial Roads, and hence no reason for vehicles to leave the pavement except for emergency parking, a grassed swale drain may be a valid alternative to the use of kerb and channel.

In this case the pavement surfacing should extend a minimum of 0.5m beyond the nominal lane width, and a painted edge line be provided.

For major roads swale drainage has the advantage of complete removal of water from the pavement in the highest intensity storms, whereas with kerb and channel the width of flow on the pavement may be considerable.

The use of swale drains on major roads also provides a visual distinction which helps to establish the difference between "Residential Streets" and "Traffic Routes".

Kerb and channel may be desirable to better delineate the pavement edge at intersections, even if swale drains are used on the road generally. However, if there are frequent intersections or major accesses, as may occur on a Trunk Collector Street or Sub-Arterial Road, it may then be preferable to use kerb and channel for the full length.

KERB PROFILES

There are three basic kerb profiles generally in use:-

- Barrier (vertical or near vertical face)
- Semi - mountable
- Driveover (also known as "Layback" or "Mountable" kerb)

It is recommended that the **Driveover** kerb profile **only** be used, for the following reasons:-

- **Safety** - Driveover kerb offers vehicle drivers and cyclists a much better chance of recovering control after accidently striking the kerb.
- **Access** - the kerb may be crossed at any point for property access, obviating the need for special "crossovers".
- **Pavement Width** - drivers will drive and park closer to a driveover kerb, effectively providing more useable pavement width.
- **Parking** - while inhibiting casual parking on the verge, driveover kerb readily permits such parking when necessary.
- **Aesthetics** - driveover kerb has a "softer" profile than a barrier kerb, more appropriate for the residential environment, and the absence of a definite kerbline makes minor construction errors less noticeable.

The one possible exception to the Driveover Kerb profile could be at indented bus bays, where a Barrier Kerb profile may assist passengers boarding a bus. However, whether this benefit warrants the localised change of profile is arguable.

KERB AND CHANNEL

In the great majority of situations the street carriageway crossfall is to the kerb. In such cases it is considered preferable that **integral concrete kerb and channel** be used, to provide a positively graded longitudinal flow path.

Exceptions to this usual situation are:-

- One way carriageway crossfall, where a kerb only may be used, on the high side of the carriageway;

- Medians and Traffic Islands, where the carriageway crossfall is away from the median or island, and again a kerb only is appropriate.

RECOMMENDED PROFILES

Various kerb and channel profiles are currently in use by Local and Road Authorities, the differences generally being only slight, and resulting from historical rather than practical reasons.

In the interests of standardisation, it is recommended that the profiles shown in Figure 5.1.A be accepted by all Authorities. These conform with L.G.E.A. Standard Drawing No. R-01, and are recommended as being most representative of current Queensland practice.

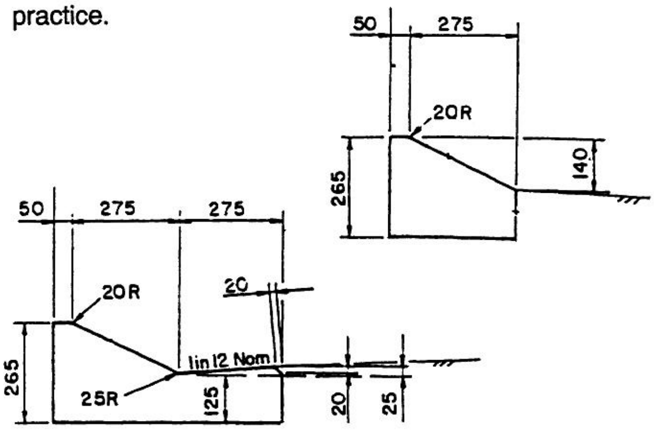


Fig. 5.1.A

5.2 UTILITY SERVICES

SERVICES WITHIN THE STREET

An important function of the Residential Street and the surrounding Major Roads is to provide a location for the various utility services required to serve an urban area.

Typically, these include:-

- Water Supply mains
- Sewerage mains (gravity and/or pressure mains)
- Electricity cables (underground and/or over head)
- Street lighting poles
- Telecommunication cable (underground and/or overhead)
- Stormwater pipes
- Gas (in some locations)

Within the residential street the sizes of service mains are normally small, being only of sufficient capacity to serve the immediately adjacent lots. However in major roads and very occasionally in residential streets, trunk mains often of considerable size may need to be accommodated, perhaps in addition to normal reticulation mains (e.g. a 600mm dia. trunk water main, plus a 150mm dia. reticulation water main).

UNDERGROUND V. OVERHEAD

Underground services are unquestionably aesthetically superior to overhead services, not only dispensing with the necessity for overhead wires and poles (other than for streelights), but also allowing unhindered opportunity for tree planting.

The safety of underground services is also greater, as overhead power lines may be brought down by storm or traffic accident, and the often substantial poles are a potential hazard to vehicles.

However, the improved appearance carries a cost penalty in the addditional cost of undergrounding. Nevertheless, the extra cost is considered justifiable in all residential development, other than perhaps the most highly cost sensitive.

A possible compromise between the aesthetics of undergrounding and the economy of overhead services may be the use of bundled overhead cables on poles along the rear boundaries of allotments, within an easement. However, electricity supply is still required in the streets for streetlighting, partially negating any potential cost saving of this option, compared to undergrounding.

SERVICE ALLOCATIONS

It is essential that each service authority have its own allocation of space within the verge cross-section, in order that services may be laid without risk of interference by or to other services, and in order that access for maintenance will not inadvertently damage other services.

Service allocations vary from one Local Authority to another, from historical rather than practical considerations. In minor streets however, it is common for Telecommunication and Electricity services to be located close to the property boundary on both sides of the street, with the watermain on one side only at 1.5m from the property boundary. Gravity sewers are normally within the allotments, with pressure mains (if present) in the watermain location but on the opposite side of the street.

While standardisation of service allocations would be the ideal, changing allocations in any one Local Authority would cause potential problems with future maintenance access.

SHARED TRENCHING

Sharing of a common trench by two or more services is a possible means of cost saving which should be pursued wherever practicable. In most cases there is no problem with Telecommunication and Electricity sharing a common trench, but electricity and water supply are often viewed by both authorities as being not compatible, due to the potential for damage and danger during access for repairs.

STORMWATER DRAINAGE

The street not only provides a location for underground stormwater drainage, but also itself forms an overland stormwater flow path to convey flows in excess of the designed capacity of the underground system.

The design of stormwater drainage systems is dealt with in detail in **"Queensland Urban Drainage Manual" (Water Resources Commission, Local Government Engineers' Association of Qld., and Brisbane City Council - 1992).**

However, the requirements for stormwater drainage must be considered by the street designer in regard to:-

- Location of streets in relation to topography to fulfil their function as overland drainage paths;
- Selection of a street cross-section to satisfy drainage capacity requirements, without risk of flooding adjoining allotments;
- Provision for adequate drainage of the street pavement and verge.

The necessity for overland flow paths from the downhill end of cul-de-sac streets needs also to be provided for. Often a pedestrian/cycle pathway may also serve as an overland stormwater flow path, and as a location for other services for which loop connections may be desirable, such as watermains and electricity.

CONDUITS

Conduits for services should generally be provided at all locations where services pass under the street or road pavement, or may be required to do so in the future.

Commonly, a watermain is laid on one side of the street only, with conduits at every second allotment boundary to carry the service connections to the lots on the other side.

Locations for likely future traffic signal installation should be identified, and conduits installed during road construction.

Conduits parallel to the property boundary may be required under parking bays, indented bus-bays, or areas planned for heavy landscaping (see Section 5.4 Streetscape).

5.3 SIGNS & PAVEMENT MARKINGS

STANDARDS

Wherever used, signs and pavement marking must necessarily conform with the provisions of the Queensland "Manual of Uniform Traffic Control Devices", and the Queensland Traffic Regulations.

MAJOR ROADS

As the major roads are **Traffic Routes**, the full range of appropriate signs and pavement marking should be provided.

RESIDENTIAL STREETS

Within the Neighbourhood, residential amenity is a major consideration, and a proliferation of traffic signs and pavement marking is certainly not in keeping with the ideals of visual amenity.

While **some** traffic signs and pavement marking may be required for safety, the emphasis should be on

designing correct traffic operation into the street system, and keeping the use of signage and marking to the **essential minimum.**

As examples, it should **never** be necessary to erect regulatory speed signs, as the appropriate speed limitation is applied by the geometric design of the street. A T-intersection does not require any signage, as the Traffic Act establishes priority without any need for a "Give Way" sign.

5.4 STREETSCAPE

DEFINITION

The "Streetscape" may be defined as the appearance, character and feeling of the total street scene.

The final effect of the streetscape depends on the inter-relationship of a number of elements, rather than on the sum of those individual elements.

ELEMENTS

These elements include:-

- Level of traffic and parking
- Sense of place and identifiable character
- Formal and informal landscaping
- Natural vegetation, especially mature trees
- Natural features and topography
- Street pavement type and alignment
- Housing forms and style
- Absence of poles and signs.

CONTROL

Only some of these elements are within the control of the engineering designer of the street.

In the case of a comprehensive development where the street, buildings and landscaping are designed as an integral whole, the final result will be the joint product of the Planner, Architect, Landscape Designer and Engineer, operating as a team, and hopefully the end result will be a harmonious integrated streetscape.

However, in the case of a subdivision of land, where the building is carried out later on the individual lots, the final effect will depend largely on the design and siting of the individual dwellings, fencing of allotments, and landscaping.

STREET DESIGN

Factors which the street designer should consider for their impact on the total streetscape include:-

Street Location

The location should be sympathetic to the topography, and flow with the contour of the land rather than cut across in a hard line.

Grading

The gradeline of the street should also follow the natural surface as closely as possible, and avoid extensive earthworks. Location and alignment may require amendment to satisfy both engineering and aesthetic considerations.

Natural Features

Street location, alignment and grading should be varied as necessary to preserve worthwhile natural features, such as individual trees or groups of trees, rock outcrops, etc.

Pavement Width

Narrow pavement width helps to create a sense of scale appropriate to the residential environment, and this is also assisted by the short lengths of visible street which result from a speed restrictive layout.

Pavement Materials

Variety in pavement material, such as block paving at "thresholds", cul-de-sac heads, parking bays and slow points also contributes to a small scale effect.

Landscaping

Street design can provide landscaping opportunities by varying the reserve and verge widths, and meandering the carriageway and footpath alignments. Tall trees help to provide vertical scale, thereby reducing the apparent horizontal scale.

Street Furniture

Minimising the number of traffic signs and utility poles, and care in the selection of items such as bus-shelters, vehicle and pedestrian barriers and street lighting poles, all help the visual amenity.

SECTION 6.0 - THE ROAD SYSTEM

QUEENSLAND STREETS

THE ROAD SYSTEM 6.0

"Roads" are **traffic routes** whose function is to convey traffic between major centres of population, or within the urban area.

In this they are functionally quite distinct from Residential **Streets**, whose primary purpose is to provide **access** to residential development.

As previously discussed, when the traffic volume reaches 2000 to 3000 vehicles per day, residential frontage becomes unacceptable from safety and amenity considerations, and the thoroughfare becomes, by definition, a **Traffic Route**.

There are of course many existing thoroughfares which do **not** comply with these concepts, i.e. "roads", whose primary function is that of a traffic route, but which nevertheless provide direct frontage to residential allotments.

6.1 CLASSIFICATION OF ROADS

Traffic Engineers and Road Authorities use various hierarchical classifications of roads, but from the point of view of the Street System four classes can be recognised, the essential difference being the degree of acceptable access between the street system and the road.

These classes are:-

* Freeway
* Major Arterial Road
* Arterial Road
* Sub-Arterial Road

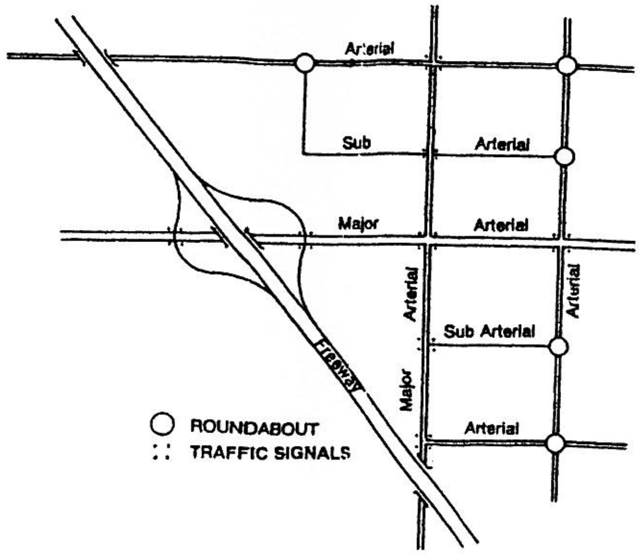
Figure 6.A shows a typical relationship between these road classes.

6.2 FREEWAYS

Roads of this category may also be described as Expressways or Motorways.

They are designed as high-speed, high-volume traffic routes. Design speed is typically 80 or 100km/h, and a cross-section with divided carriageways, each of 2 or more lanes, provides capacity for 40,000 vehicles per day upward.
Access is available only to roads of similar status or to Major Arterial roads, by grade separated interchanges at infrequent intervals, say 2km or more apart.

As Freeways provide no direct connection to the street system, their main significance to Residential planning is as a **major planning constraint** if such a road should traverse or bound the land under consideration.



THE MAJOR ROAD SYSTEM
Fig. 6.A

6.3 ARTERIAL ROADS

CHARACTERISTICS

Arterial roads have the primary purpose of conveying through traffic with its origin and destination relatively remote from the residential area under consideration.

However, within this broad classification there is a wide range of:-

- Traffic served, from inter-regional to intra-urban
- Traffic volume carried
- Traffic speed

From the point of view of the Residential Street system, the main distinction is in the degree of access permissible from the Street system to the Arterial. Quite arbitrarily, a subdivision can be made into:-

- Major Arterial Roads- Generally no intersection with Residential Streets
- Arterials - Limited intersection with Residential Streets

STANDARDS

Design and construction standards for Arterial roads will generally be determined by the Local Authority and perhaps the Department of Transport if the road is of regional or State significance, or is likely to become a Declared Road.

As a guide only, typical standards for Arterial Roads could be:-

	Major Arterial	**Arterial**
Reserve Width	40-60m	30-40m
Cross-Section	Divided Carriageways Each 2 or more lanes Median 6.0m min	Divided Carriageways Each 2 lanes Median 6.0m
Design Speed	80-100km/h	60-80km/h
Capacity	30-60,000 vpd	20-30,000 vpd
Intersection Type	Generally signals, possibly grade separation or roundabout	Signals or roundabout
Intersection spacing	1000-2000m	500-1000m
Intersect with	Freeways, major arterials, arterials, possibly sub-arterials	Major arterials, arterials, sub-arterials, possibly trunk collector streets
Frontage Access	Nil	Nil (except possibly to major development)

STAGING

Often construction of an Arterial Road will be staged, the road either existing or being constructed initially as a two-lane road, and later being widened to four or more lanes by construction of a second carriageway.

However, it is **essential** that the land requirements for the ultimate road reserve be recognised and provided for in the initial development planning.

6.4 SUB-ARTERIAL ROADS

CHARACTERISTICS

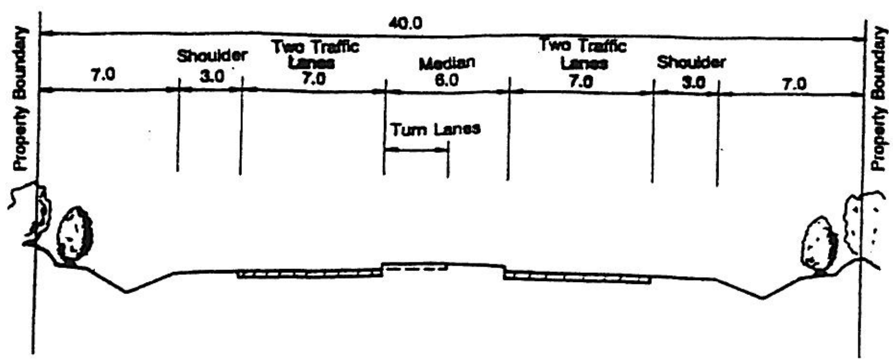
Unlike Freeways or Arterial Roads, Sub-Arterials do not carry any major through traffic component, but act as feeder roads between residential areas and the Arterial Roads.

They are needed to further subdivide larger areas between Arterial Roads, or to reduce the number of intersections with Major Arterials or Arterials. (See Section 3.2).

Commonly, Sub-Arterial Roads terminate at a T-intersection with an Arterial Road at either end. Excessive continuous length across Arterials will tend to encourage their use by through traffic as a "parallel arterial".

CAPACITY

If designed to discourage through traffic, and if serving only a normal residential neighbourhood, a typical Sub Arterial Road "catchment" is unlikely to exceed about 1800 allotments, producing a total traffic volume of about 12,000 vehicles per day, perhaps 8,000 v.p.d. maximum with a 2/3 - 1/3 directional split. (See figure 6.C and Section 3.2).



TYPICAL ARTERIAL ROAD
Fig 6.B

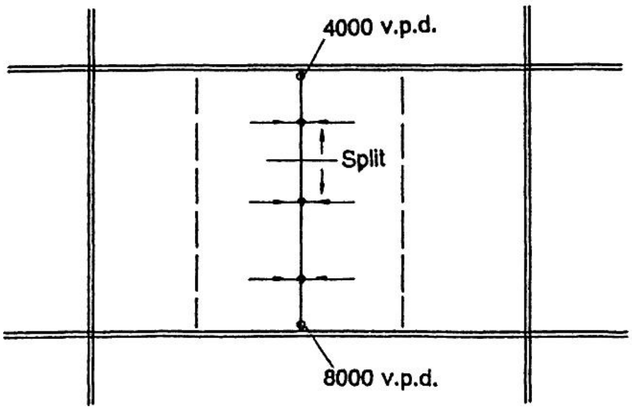


Fig 6.C

This is well **within the capacity of a two-lane road** (maximum approximately 15,000 v.p.d.), and hence only in unusual circumstances would a four lane cross-section be required, e.g. access to a major generator such as a district shopping centre, or a layout which encourages through traffic.

INTERSECTIONS

The Sub-Arterial Road is unequivocally a traffic route, but the lower traffic volume and speed compared to Arterials and Major Arterials can safely allow for intersections at relatively frequent intervals, approximately 100m minimum, depending on geometric design.

Intersections may generally be uncontrolled T-junctions, or signalised or roundabouts for 4-way intersections. It is likely that in every case full channelisation and appropriate auxiliary lanes will be required to provide adequate intersection capacity.

ACCESS

While the Sub-Arterial Road must not provide direct frontage for residential lots, it **may** provide access for such uses as Multi-unit developments, Schools or Shopping Centres, provided that:-

- Provision is made for internal turning of vehicles and hence ingress and egress are in a forward direction only.
- The accesses are provided with auxiliary lanes and channelisation as necessary, and the spacing between intersections and accesses is as specified for intersections.
- Appropriate buffer strips are provided.

STANDARDS

Design and construction standards for Sub-Arterial roads may be determined by the Local Authority, as part of an overall Road Plan, or in the case of a larger development where the need for the road is necessitated by the development planning, the design criteria may be initiated by the development.

As a guide only, typical standards for two-lane Sub-Arterial Roads could be:-

- **Reserve Width**
  20 - 32m (dependent on selected drainage system, and intersection geometry - see Figure 6.D)
- **Carriageway**
  Travel lanes - 2 x 3.5m
  Provision for additional auxiliary lanes and future bus bays. Kerb and channel, or grassed swale drainage optional. See Figure 6.D for alternative cross-sections.
- **Design Speed**
  - 60 km/h
- **Parking**

  No provision - Design to discourage on-road parking e.g. adequate on-site parking for adjacent development, and landscape or fence barriers between road and development.
- **Intersections**

Arterial or other Sub-Arterial	Signalised, roundabout or "T" (all movements or left in/left out)
Residential Collector	T, roundabout, or signalised 4-way
Access Street or Access Place	Undesirable
Average spacing	300m
Minimum spacing	varies with geometric design

All intersections and major development accesses (e.g. schools, shopping centres, multi-unit developments) to be provided with right turn, deceleration, and passing lanes, 3.0m wide. Channelisation at intersections and accesses is generally necessary.

- **Bus Bays**

  Sufficient width for future indented bus bays at appropriate locations (e.g. schools, shopping centres, pedestrian routes).

- **Pedestrians and Cyclists**

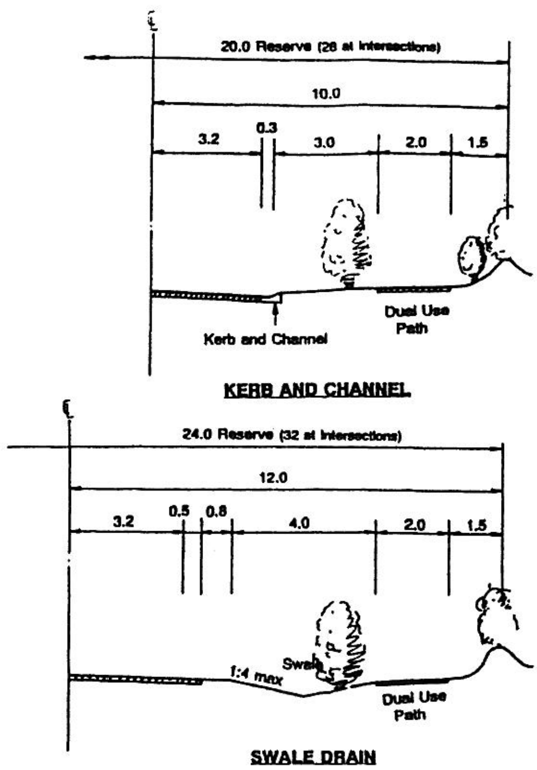
  Provision dependent on overall planning. Generally Dual-Use pedestrian/cyclist paths in verge one or both sides, or provision on alternative route locations.

- **Services**

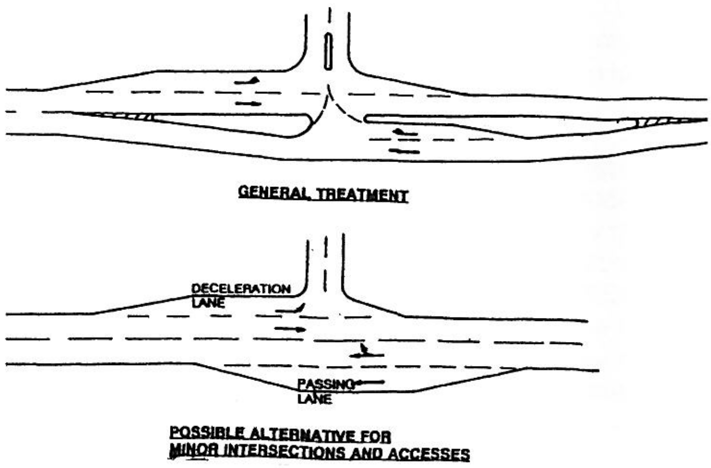
  Verge width sufficient for possible major services required.

- **Aesthetics**

  Mounding and landscaping to be provided. Uniform fencing erected by the developer is desirable.



SUB-ARTERIAL ROAD ALTERNATIVE CROSS-SECTIONS



SUB-ARTERIAL ROAD TYPICAL DETAILS
Fig 6.D

6.5 SPACING OF ARTERIALS

Most Major Arterials, and many Arterials, will have been in existence as rural roads of varying importance prior to urbanisation of the area. In this case their location may be random, as far as residential development is concerned, having been dictated by topography and original property boundaries.

On the other hand, if they have been constructed or planned specifically to serve the urban development, they will tend to be located at more or less regular intervals.

Sub-Arterial Roads are virtually all in this latter category, being generally planned only as part of the urban development.

Subject to constraints of topography and existing roads and development, Major Roads within an urban area would ideally be located in an approximately square "Grid" pattern.

The optimum spacing is a compromise:-

Larger Spacing;

Greater total travel distances and times; (Greater distance and times on minor streets can lead to driver frustration and speeding, and tendency for "rat-running" through residential areas.)

Increased traffic volume on minor streets. (Resulting in loss of amenity and reduced safety.)

Lesser Spacing;

Increased capital road cost and undue fragmentation of residential areas.

Traffic Engineers often consider a spacing of about **1500m** to be the optimum from a road capacity point of view, but Residential Planning considerations indicate a slightly lesser spacing of about 1200m to 1300m as being the optimum. This order of spacing results in the creation of a series of viable Neighbourhood areas each of approximately 150 to 180 hectares. (see Section 3.2).

THE ROAD SYSTEM

OBJECTIVES

- To provide an efficient system of traffic routes external to the Residential Street system.

PERFORMANCE CRITERIA

MAJOR ARTERIALS & ARTERIALS

- The arterial road network to be designed and located so that it provides routes which are more convenient for external traffic than the residential street network. Arterial roads should be provided at intervals of not more than 1.5 Kilometres and have the capacity to accomodate projected movement.
(AMCORD P2, page 46)

SUB - ARTERIALS

- Location such that the total major road network results in the creation of viable Neighourhood areas.
- Location and design to discourage through traffic between Arterial roads.
- Location and design to provide efficient connection and traffic interface between the Residential Street system and the Arterial Road system.
- Road length to be the minimum necessary to perform the intended functions.
- Location and design of intersections to Arterial roads to be to the requirement of the relevant Road Authority.
- Location such that the traffic volume, (assessed in accordance with Section 2.3) does not exceed 15,000 v.p.d.
- No direct access to be available to the road from residential allotments.
- Design standards in accordance with Section 3.5..
- Detailed geometric design in accordance with relevant NAASRA (Austroads) standards.

ACCEPTABLE SOLUTIONS

MAJOR ARTERIALS & ARTERIALS

- Detailed design to the requirements of the relevant road authority (Local Authority or Department of Transport) and/or in accordance with relevant NAASRA (Austroads) standards.

SUB-ARTERIALS

- Location such that the Neighbourhood areas created by the total major road network are 150 to 180 hectares in area.

SECTION 7.0 - DEVELOPMENT CONCEPT DESIGN

DEVELOPMENT CONCEPT DESIGN 7.0

While the Concept Design is the first phase of the actual Development Planning process, it cannot be commenced without a knowledge of the detailed requirements of each of the elements which comprise the development as a whole, and hence its consideration as the final Section of these Guidelines.

7.1 FACTORS IN CONCEPT DESIGN

Factors which need to be considered in the development concept design include:-

Land Use

- Council Town Plan zoning, Strategic Plan and/or Development Control Plan designation, and Subdivision Bylaw provisions relating to the subject land.
- Requirements of other Authorities, e.g. major road, railway or utility routes, school sites.
- Environmental constraints e.g. wetlands, fish habitats, preservation areas.
- Topographic constraints e.g. steep land, flood prone land, filled areas, slip areas, contaminated land.
- Developer's preferences - land uses, allotment dimensions, housing types.
- Adjacent land uses or zonings - compatability, buffering requirements
- Aspects - views, prevailing winds, solar exposure.

External Traffic Destinations-

- Vehicular, pedestrian and cyclist e.g. shopping centres, schools, sport and community facilities, railway stations, bus routes, employment centres.

Roads

- Major regional road system (existing or planned)
- Points of connection to major roads (direct or via intermediate roads, and either nominated by road authority or selected by designer).
- Existing or planned major roads within the subject land.
- Adjoining roads or streets, and connection opportunities or limitations.

Pedestrian, Cyclist and Bus Routes

- Existing or planned facilites adjacent to the development
- Requirement to extend facilities within the subject land.

Stormwater Drainage

- Major drainage paths to be extended through, or provided within, the land
- Drainage discharge requirements e.g. quantity or quality limitations, lawful point of discharge.

Utilities

- Existing or planned utility services within the land
- Points of connection and capacities available to serve proposed development.

Open Space

Council requirements for Open Space dedication

- Extension of existing or planned open space corridors within the land.

7.2 SPECIALIST INPUT

From the above list of factors requiring consideration it is evident that for all but the most minor subdivision the formulation of the Development Concept Plan should be a multi-disciplinary exercise, with, as a minimum, Town Planning and Civil Engineering input. In many cases further specialist input may be required, such as:-

•	Traffic Engineering	(traffic studies)
•	Surveying	(topographic and cadastral)
•	Geotechnical engineering	(slope stability and building constraints)
•	Hydraulic engineering	(flooding and drainage)
•	Environmental science	(flora and fauna, water quality, site contamination)
•	Architectural	(building design)
•	Landscape architecture	(streetscape, parks, open space)
•	Archaeological/Heritage	(development constraints)
•	Market research	(maximising return)

7.3 CONCEPT DESIGN PROCESS

CONCEPT DESIGN

While the two are inter-related, the Concept Design may be considered to have two major components:-

- **Land Use Plan, and**
- **Transport/Services Plan**

Typically, the process commences with a tentative Land Use proposal, as a **"Bubble Plan"**, based on the initial assessment of land use constraints and opportunities, and this concept is refined and modified as necessary as the Transport/Services component is developed.

TRANSPORT/SERVICES COMPONENT

The Transport/Services component may consist of several **"Networks"**.

- Roads and Streets
- Pedestrian/Cyclist facilities
- Bus Routes
- Railway Routes
- Stormwater Drainage
- Utility Services
- Open Space areas

These overlap and are inter-dependent to a large extent, and therefore must be considered in conjunction with each other, e.g.

- Pedestrian/Cyclist facilities are most economically provided in low traffic volume streets, Open Space areas, (desirably **not** following major Arterial roads.)
- Bus Routes must be located on roads and higher-order streets.
- Stormwater drainage paths **must** be clear of development, in roads or streets for minor flows, in Open Space areas for major flows.
- Utility services must be located in roads, streets or open space areas.

NETWORK DESIGN

The design process for the Transport/Services networks will vary with the scale of the development, and the degree of constraint existing. However, the following sequence will generally be appropriate:-

Identify and Assess Constraints

Some constraints may be absolute, but most can be removed, at a price. e.g. relocation of existing roads or services.

Stormwater Paths

Locate all major stormwater paths and distinguish between those which may be accommodated in roads or streets and those where the volume of overland flow will require open-space location.

Major Roads

Locate any required new Major Roads, to conform with Road Authority overall planning, and desirably to provide a "grid" to create viable neighbourhoods of 1200 to 1800 lots.

Check that grading, alignment and intersection locations are satisfactory.

Neighbourhoods

Subdivide each Neighbourhood into "cells" of 200 to 300 lots potential, and locate the site of neighbourhood facilities.

Collector Streets

Locate Collector Streets to connect each cell to Major Roads and interconnect cells to Neighbourhood facilities.

Check grading, alignment and intersection locations, and that Collector Streets are **not** located such that "rat-running" by through traffic is encouraged.

Bus Routes

Check that the proposed Major Roads and Collector Street system can provide an efficient and coherent bus route system. Adjust as necessary.

Some compromise between efficient bus routes and discouraging through traffic in Collector Streets is probably necessary.

Pedestrian/Cyclist Routes

Identify desirable Pedestrian/Cyclist routes, linking all destinations with each "Cell", with minimum travel distances and minimum grades.

These may follow open space or Major Road routes. Otherwide provision will be required for them in detailed design, by location of minor streets, park strips or pathways to follow the selected routes.

Utilities

Special provision for utilities is generally not necessary, other than to accommodate an existing major service in a road reserve or open space area.

However, connections to avoid dead-end services and provide alternative routes can be provided through appropriately located pathways and park strips.

A number of trials may be necessary to best satisfy all network criteria, and particular attention should be given to eliminating or minimising potential conflicts between Pedestrian/Cyclist routes and major roads. Inevitably the "final" Concept Plan will be further amended in the detailed design phases, both of the various Transport/Service Networks and of the individual Residential Neighbourhoods.

SECTION 8.0 - DEFINITIONS

Acceptable Solutions are provisions which are accepted without any further evidence being required as one option for meeting the performance criteria. (where any deemed-to-comply criteria contains alternatives, the choice rests with the proponent.)

Access place - A minor cul-de-sac street providing local residential access, with shared traffic, pedestrian and recreation use.

Access Street - A street providing local residential access with shared traffic, pedestrian and recreation use with local traffic access priority.

Allotment - An area of land shown on an approved plan of subdivision, and on which it is intended to construct a dwelling or dwellings.

Approved Construction Standard - Any specification document as described by the words "Approved Construction Standard" adopted by the Responsible Authority and which outlines the standards of construction for pedestrian paths, bicycle paths, streets and roads. **Approved construction standard** also includes geometric design standards where not otherwise specified in these provisions.

Arterial Road - A road serving through traffic, with origin and destination relatively remote from the residential area under consideration.

Bike Lane, Path etc - See Cycle.

Carriageway - The area of street or road reserve which is provided for the movement or parking of vehicles.

Collector Street - A street providing for local residential access and local traffic movement within performance limits defined in this Code.

Cycle lane - A lane within the street carriageway separated from other vehicles by line marking or a physical barrier, and signed for use by cyclists.

Cycle path - A pavement intended only for bicycle traffic, separate from the street or road carriageway, either within or outside a road reserve.

Cycleway - A complete bicycle travel network, which can include such components as Cyclepaths, Cyclelanes and Dual-use paths.

Design Speed - The Street Speed (q.v.) selected as being appropriate for a street, for design purposes.

Distributor Road - A road whose primary purposes are to provide connection between the residential area and the arterial road system, and circulation within a major residential area.

Dual-use Path - A pavement intended and sign posted for dual use by both pedestrians and cyclists, separate from the street or road carriageway, either within or outside a road reserve.

Footpath - A pavement intended only for pedestrians, separate from the road or street carriageway, and either within or outside a road reserve.

Landscaping - Any element or feature of the street, either man-made or natural.

Lane - A width of the carriageway of a road or street sufficient for the movement or parking of a vehicle. In Residential streets lanes are generally not formally delineated.

Legibility - The ease of understanding, or lack of confusion, of the street layout.

Lot - See Allotment

Nature Strip - See Verge

Objectives - Statements of the desired outcomes to be achieved in the completed development.

Off-Street Parking (or On-Site Parking)
Vehicle parking within the boundaries of private properties.

On-Street parking - Vehicle parking within the street or road reserve, on the carriageway, in constructed parking bays, or on the verge.

Pathway - A strip of land, solely or mainly for the purpose of accommodating a Path, viz a Footpath, Cyclepath or Dual-use Path.

Pavement - The structural composition of a street or road carriageway.

Performance Criteria - Criteria to be used in the preparation, submission and assessment of development proposals for measuring performance of the proposals against element objectives.

Potential Bus Route - A connected series of Roads or Streets identified as a suitable route for buses to travel through a residential area.

Property Line - The street frontage of an allotment, defines the boundary between public and private property.

Public Open Space - Land used or intended for use for recreational purposes by the public including parks, public gardens, streamside reserves, pedestrian and cyclist accessways, playgrounds and sports grounds.

Qualified Person - Any person accepted by the appropriate drainage, sewerage, water or electricity reticulation authority to design such utilities, as evidenced by the issue of a certificate of registration by that authority or by the appropriate State authority.

Residential Street - A street within a residential area which serves the needs of residents and usually, but not necessarily, provides frontage to dwellings.

Road - Any public thoroughfare whose primary purpose is the conveyance of vehicular traffic.

Road Reserve - The land dedicated to the Crown for the purpose of a road or street, and incorporating the full width from property line to property line.

Spot Speed - The 85 percentile maximum operating speed (i.e. the maximum speed not exceeded by 85% of vehicle) at a **particular** point within a street.

Street - Any street, lane, square, court, alley etc. whose primary purpose is providing access to residential buildings.

Streetscape - The visible components within a street (or part of a street) between facing buildings, including the form of buildings, setbacks, fencing, landscaping, driveway and street surfaces, utility services and street furniture such as lighting, signs, barriers and bus shelters.

Street Speed - The 85 percentile maximum operating speed attained at **any** point within a street.

Verge - That part of the street or road reserve between the carriageway and the boundary of adjacent allotments (or other limit to street reserve). It may accommodate public utilities, footpaths, stormwater flows, street lighting poles and planting.

V. R. Ward, Government Printer, Queensland—1993

SECTION 8.0 - RURAL RESIDENTIAL STREETS

QUEENSLAND STREETS

BACKGROUND 8.1

DEFINITION

Rural Residential development may be defined as the provision of sites for separate dwelling houses on allotments larger than normally found in urban areas, to provide for low-density residential living without all normal urban facilities, but still providing a reasonable standard of accessibility and services.

HISTORY

The earliest form of "Rural Residential" development was unplanned, originating as larger lots subdivided on the outer fringes of cities and towns, with low standard access streets and few if any services. Because land prices were relatively cheap, some of these areas developed as semi-slums. Most of these early examples have now been upgraded, typically at considerable cost to Local Government.

However during the last two or three decades a large number of planned Rural Residential developments have taken place on the fringes of urban areas, many to deliberately high standards.

Experience has indicated a fairly limited market for this form of development, and a tendency for relatively high turnover of residents. Marketing success is very dependent on location, services available, and the local market demand.

VARIATIONS

While most Local Governments in or bordering substantial urban areas recognise and make provision for **Rural Residential** development in one form or another, there is wide variation both in nomenclature and in the applicable development standards.

NOMENCLATURE

The terms:

- **Rural Residential**
- **Park Residential** and
- **Low-Density Residential**

are commonly used, either as alternative terms for similar development, or within the same Council for variations in development density. Some Councils have as many as five different categories.

ALLOTMENT DIMENSIONS

A survey of local government by-laws indicates the following range of requirements for Rural Residential type development:-

- **Minimum Area: 1200m² - 2.0ha**
- **Minimum Frontage: 30m - 70m**

However, eliminating what are essentially larger conventional Residential lots, the majority of allotment standards are within the range:-

- **Minimum Area: 4,000m² - 8,000m²**
- **Minimum Frontage: 40m - 50m**

CONSTRUCTION STANDARDS

Construction standards also vary considerably between Councils, the major variables affecting road design being:

- **CARRIAGEWAY DRAINAGE**
  May be either **Kerb and Channel**, or **Shoulders and Swale Drains.**

- **UNDERGROUND DRAINAGE**
  May vary between virtually **Urban Drainage** standard, (full underground drainage other than in defined natural watercourses), and **Rural type** cross-road culverts only.

- **CARRIAGEWAY SURFACING**
  May be either **Asphaltic Concrete** surfacing, or **Bitumen Seal.**

- **SERVICE PROVISION**
  Electricity Reticulation is always required, but may be either overhead or underground distribution.
  Water Reticulation is usually required.
  Sewerage Reticulation is generally **not** required.

PLANNING PHILOSOPHY

A Council's standards for Rural Residential roads and streets should reflect the Council's planning philosophy in regard to this form of development. However in many cases such a philosophy has not been formally expressed and the development standards may have evolved over a period of time in response to various factors, sometimes conflicting.

While there will be valid variations in Rural Residential Planning Philosophy between Councils, due to differences in such factors as topography, market demand for such development and the value of agriculture land, the following conclusions are probably valid in the majority of cases:-

- **Rural Residential** is a **valid housing and lifestyle alternative**, and therefore a managed supply of land for such development should be provided.

- However, it is **extravagant of land and inefficient in the provision of services** and hence should be regarded as a "luxury" form of development.

- Development should be located in **reasonable proximity** to existing or future urban centres where necessary **community services** will be available.

- Such development should **not** be located on land likely to be required for **future urban use, viable agricultural land**, land of significant **environmental value**, or land with **extractive resources**, nor where it would conflict with these land uses. Future re-subdivision into smaller lots presents great difficulties in appropriately upgrading streets and services.

- Location and design should be such as to **prevent environmental degradation** of land and water, and to **avoid hazardous areas** such as land subject to flood, instability, or high fire risk.

Application of these general Planning Principles to the specific aspect of **Road and Street Standards** results in the following conclusions:

- **DESIGN & CONSTRUCTION STANDARDS**
  Roads and streets should provide for all present and future needs, to reasonable public expectations, with no foreseeable requirement for future capital works and with minimum future maintenance costs.

- **FINANCIAL CONTRIBUTION**
  An appropriate contribution to upgrade existing roads, to which the development will contribute traffic, is a reasonable requirement.

- **TOPOGRAPHY**
  Exclusion of land suitable for urban uses, viable agricultural land, and land of environmental value means that Rural Residential development will often be on land of marginal topographic suitability. Road grading, allotment access, slope stability and drainage may therefore be significant design constraints.

- **ENVIRONMENT**
  Road location and design, and future house sites and allotment accesses, should minimise earthworks and tree clearing, to reduce visual impact.

  Preferred road location (eg, ridgetops) may be environmentally unacceptable. Possible environmental hazards (eg, flooding, bushfires, slope stability) require consideration in road location.

- **TRAFFIC GENERATION**
  Prediction of traffic volumes will be facilitated, since future re-subdivision into smaller lots should be unlikely, and the locations of future services and facilities are identified.

GOAL AND OBJECTIVES

The recommendations for **Rural Residential** street design are based on the same philosophy as set out in Section 1.7 of these Guidelines, viz:

Goal: Streetworks design and construction practice which provides an **Optimum Combination** of:-

- **Safety**
- **Amenity**
- **Convenience**
- **Economy**

for **subdivision residents, street users, and the community generally.**

The **Optimum Solution** for each design and construction element is that which provides the most appropriate balance between the often conflicting ideals of these four **Primary Objectives.**

While the basic philosophy remains the same, the physical variations between conventional Residential and Rural Residential development mean that the optimum solution is in many cases different.

SIGNIFICANT DIFFERENCES

The physical variations between residential and Rural Residential development which have most significance in the application of these principles to Rural Residential street design are:-

- **ALLOTMENT FRONTAGE**
  The wider frontages (eg, 50m compared to 18m) result in much greater travel distances for a given number of allotments, and hence the acceptable travel time in a speed-restrictive environment becomes a much more significant limitation. The greater distances also result in more reliance on motor vehicles, and less pedestrian and cycle traffic on the street.

- **ALLOTMENT AREA**
  The larger allotment areas (eg 6000m^2 compared to 600m^2) generally result in greater set-back of dwellings from the street boundary.

  This reduces the impact of traffic noise on amenity, provides much greater capacity for on-site parking, and encourages parking within the site, rather than on the street. There is also less likelihood of children playing on the street.

- **STREET RESERVE WIDTH**
  Street reserve widths tend to be greater (typically 20m or more compared to 15m) resulting in increased verge width. This again reduces traffic noise impact, provides increased safety visibility distance, and where on-street parking does occur tends to encourage parking on the verge rather than on the carriageway.

APPLICATION OF GUIDELINES

The appropriate limits of application of these Guidelines may be dependent on a number of factors, principally allotment frontages and area as indicated above, but possibly also topography and development layout, which may affect drivers' travel speed and travel time expectations.

As a guide, the following limits are suggested.

- **Lot frontages up to 25m and areas of up to 2000m^2:**

  - Use conventional **Residential** design Guidelines (Section 2.0)

  For larger frontages eg, 30-35m check that the maximum travel time does not exceed 90 seconds. If so, modify subdivision layout or use **Rural Residential** guidelines.

- **Lot frontages 40m to 70m and areas 2000m² to 2.0ha:**
  - Use these **Rural Residential** guidelines.
- **Frontages above 70m and areas above 2.0ha:**
  - Use conventional **Rural Road** design criteria.

A combination of **Rural Residential** criteria for Access Streets and **Rural Road** criteria for Collectors may also be an option for these larger lot developments.

GENERAL

As discussed for Residential streets (Section 2.7), while the ideal is for all streets with frontage access to have low design traffic speed and low design traffic volume, subdivision layout necessitates that this ideal must inevitably be compromised to some extent in some streets.

In the case of **Rural Residential** development, the principal constraint is the limitation of travel time in a speed restrictive environment, which necessitates accepting a higher design speed in the "trunk" streets to keep total travel times within reasonable limits. Hence a "hierarchy" of streets is inevitable.

CLASSIFICATION

For Rural Residential streets a nomenclature system similar to that for Residential streets is adopted, viz:-

- **Access Place**
  A single cul-de-sac
- **Access Street**
  A "stem" from which two or more cul-de-sac streets branch, or a "loop" street.
- **Collector Street**
  A "branch" which connects to a major street or road.

ACCESS PLACE AND STREET

As for Residential streets, the distinction between the Access Place and the Access Street is one of "form" rather than "function", and hence the design criteria are the same for both.

COLLECTOR STREET

The **Collector Street** will generally have a number of Access Streets branching from it, possibly Access Places, but may occasionally be the "downstream" end of a very long single cul-de-sac.

The Collector Street is the highest category of Rural Residential street providing direct access to allotments. It will connect to a **Connecting Road** ("**Road**" as distinct from "**Street**") at its "downstream" end, which will provide the connection to the external road system.

CONNECTING ROADS

Connecting "Roads", as distinct from the "Streets" having direct access to Rural Residential lots, link the rural residential development to the external road system. Two general types of connecting road may be identified:-

- **Internal** - within the Rural Residential area, but having no frontage access due to design requirements (generally travel time limitations).
- **External** - generally an existing road forming a boundary of the Rural Residential development.

The "**Internal Road**" is analogous to the Residential "Trunk Collector" as described in Section 3.7, while the "**External Road**" identifies with the "Sub-Arterial" or "Arterial" Road.

While the Connecting Roads cannot have Rural Residential lots directly fronting them, larger lots of "Rural" size may generally be allowed to have direct frontage, provided that the traffic volume is not unduly high, and lot accesses are appropriately located. Such Connecting Roads will generally be **Rural Roads** in character, and designed to appropriate Rural Road standards, (eg Austroads).

In some cases, where the Rural Residential development abuts Urban development, the "External Road" could be a **Major Road**, eg Sub-Arterial or Arterial, with no frontage lots.

EFFECT OF TRAFFIC SPEED

As detailed in Section 2.3 of these Guidelines, high traffic speed in streets is detrimental most significantly to the **safety** of residents and street users, and also to the **amenity** of residents from increased noise.

Lower traffic speed results in a reduction both in the number of accidents and in the severity of injuries, particularly where pedestrians or cyclists are involved.

The most effective means of providing a **consistently** lower traffic speed is by restrictive geometric design based on a selected "**Design Maximum Speed**".

SPEED AND SAFETY

In **Rural Residential** streets some increase in Design Speed, compared to Residential standards, can be acceptable without significantly compromising safety, as:-

- **Pedestrians and cyclists are few**, due to the generally long travel distances to facilities, resulting in use of the car rather than foot or cycle travel.

- **Children playing** on the street are rare, due to the larger allotment areas.

- **Safety Visibility** of a driver to a child running from a house onto the street, or a car exiting from an allotment is generally greater than in a residential street, due to (typically):-
  - greater setback of houses from the street
  - greater verge width
  - fewer parked vehicles either on the carriageway or the verge
  - few high fences

TRAVEL TIME

From considerations of **safety** and **amenity** "slowest is best". However this ideal must be tempered by the practical limitation of the resultant increased travel times within the speed-restrictive environment - the objective of **convenience.**

For Residential streets the recommended maximum low-speed travel time is **60 to 90 seconds** (Section 3.9), but for Rural Residential development the travel distance per lot is much greater in proportion to the allotment frontages (eg, 50m compared to 16m - 18m, or about 3:1). Hence except in a very small development the travel time in the speed-restrictive environment would become unreasonably long at the Residential design speeds of 30 and 40 km/h, and the resultant **average** travel speeds of about 25 and 30km/h, assuming 20km/h "slow points".

For example, for an average speed of 30km/h and travel time of 90 secs, the maximum street length is 750m, or only about 34 lots (with average frontages 50m and 4 lots at the head of the cul-de-sac).

Hence it is apparent that **some increase in Design Speeds and / or Travel Times is necessary** for practical design of most Rural Residential development.

On the other hand it is reasonable to assume that the higher the average speed the longer the travel time acceptable at that speed without driver frustration, up to perhaps **60 km/h**, which should be an acceptable speed for a reasonably extended time.

Extrapolating from the Residential recommendations the following maximum travel times for various design speeds may be reasonable:- (see Table 8.4.A)

MAXIMUM TRAVEL TIME

Design Speed (km/h)	**Average** Speed (km/h)	**Total Travel** Time (secs)
30	25	60
40	30	90
50	40	120
60	50	180
	60	No limit

TABLE 8.4.A

Note: Average Speed assumes "Slow Points" with 20 km/h negotiation speed for Design Speeds of 30 and 40km/h. For higher Design Speeds, speed restriction is assumed to be by less restrictive Slow Points, or curvilinear street alignment.

DESIGN CRITERIA

DESIGN SPEEDS

While recognising that lower Design Speeds are preferable, it is considered that in the circumstances, **60 km/h** is reasonable as the **highest "Design Maximum Speed" for Rural Residential streets with allotment access.** This speed then would be applicable to the **Collector Street** system.

For the minor streets, ie the **Access System,** a lesser design speed is appropriate. Fairly arbitrarily, **45 km/h** is recommended as a reasonable compromise. The ratio of Collector to Access design speed is therefore consistent with the Residential design speeds (ie 4:3).

TRAVEL TIMES

From Table 8.4.A, appropriate maximum total travel times would be:-

- **Access System:**
  - **90 to 120 seconds**
- **Collector System:**
  - **180 seconds total**
  (including travel in the Access System).

TRAVEL DISTANCES

Equivalent total travel distances (ie street lengths) are:-

- **Access System**
  (av. speed 35km/h = 9.72 m/sec)
  90 secs - 875m or 120 secs - 1167m
- **Collector System**
  (av speed 50km/h = 13.89 m/sec)
  90 secs - 1250m or 60 secs - 833m

Totals
180 secs - 2125m or 180 secs - 2000m

SPEED RESTRICTIVE DESIGN

Speed restrictive design may be applied in accordance with the recommendations of Section 2.3 of these Guidelines, using any of the methods detailed therein, ie limited street length, slow-points, curvilinear alignment, or combinations thereof.

However in the case of **Collector Streets,** restriction should desirably be by **street alignment only,** with a minimum speed of 40 km/h, to avoid an excessive difference between the maximum and minimum vehicle speeds, in the interests of safety and driver convenience.

For **Access Streets,** where slow-points are necessary their design should be somewhat "freer" than in Residential streets, with negotiation speeds of perhaps 25 or 30 km/h, again to prevent excessive speed range.

TRAFFIC SPEED

OBJECTIVES

- To provide a street environment which allows all users - motorists, pedestrians and cyclists - to proceed safely and without unreasonable delay, (AMCORD 02, page 60), and which preserves residential amenity.

PERFORMANCE CRITERIA

- The design features of each type of street to convey its primary function and encourage appropriate driver behaviour. (AMCORD P4, page 62).
- Design of the carriageway to discourage motorists from travelling above the intended speed, by reflecting the function of the street in the network. In particular, the width and horizontal and vertical alignment not to be conducive to excessive speed, (AMCORD P5, page 62).
- Street design geometry which effectively restricts vehicular speeds to appropriate limits.
- Street layout which limits motorists travel time within the speed-restrictive environment to acceptable limits.

ACCEPTABLE SOLUTIONS

- Design Maximum Speed of 60 km/h in the Collector Street system and 45 km/h in the Access Street system.
- Speed restrictive design in Collector Streets by street alignment only, with a minimum speed of 40 km/h.
- Where "Slow-Points" are used in Access Streets, geometry to provide for a minimum of 25 km/h.
- Street leg lengths and curve radii for speed restrictive design in accordance with criteria of Section 2.3.
- Maximum travel time of 90 seconds in the Access Street system, and 180 seconds total in the Access Street and Collector Street systems.

TRAFFIC GENERATION

As noted in Section 2.2, Traffic Generation Rates from residential development can vary widely, dependent on a number of factors as detailed therein.

Compared to conventional residential development, a higher generation rate could be expected from Rural Residential development as:-

- **Schools, shops and services** are generally at a considerable distance, requiring use of a car to access;
- **Public transport** is generally non-existent or at a considerable distance; and
- **Two-car households** would usually be the norm, due both to necessity and the generally higher economic bracket of residents.

On the other hand, because of the longer distances involved, trips are more likely to be planned to minimise their number - eg, combining school pick-up and shopping, sharing school drop-off and pick-up between families.

It is recommended that locally recorded generation data be used wherever available, as the characteristics of Rural Residential development may vary considerably.

However, as a guide where local data is not available, traffic counts in high standard developments in Albert and Pine Rivers Shires indicate generation rates closely approximating those in Residential areas, viz:-

- **Daily** — **10 trips/house/day**
- **Peak Hour** — **1.1 trips/house/hour** (Typical split 0.75/0.35)
- **Heavy Vehicles** — 5%

ASSESSMENT OF TRAFFIC VOLUME

Assessment of the traffic volume at any point in the street system may be readily made using the method set out Section 2.2 of these Guidelines. In general Rural Residential street layouts are simple branching layouts with few loop streets, and all traffic generators are usually in the same direction, thus making the assessment process even simpler.

However, some Planning issues which can affect future traffic volumes must be emphasised:-

- **Exclusion of Through Traffic**
  As for Residential subdivision, the street layout must be such that **through traffic is positively prevented**, to ensure that only traffic actually generated by the local traffic catchment uses the street.
- **Future Re-subdivision**
  Rural Residential development will not normally be considered as subject to future re-subdivision to higher density (eg, Urban Residential), because Rural Residential should **not** be permitted on land identified as being suitable for future urban development.
- **Future Extension of Traffic Catchments**
  Consideration **must** be given to likely future extension of streets which may result from subdivision of adjacent land, and include the estimated future traffic from such development in the design traffic volumes and travel distances.
- **Future Traffic Generators**
  The probable location and nature of future traffic attractions, such as Schools, Shopping Centres, and Community Facilities, must be considered in traffic assessment, as well as any existing such generators.

AMENITY

The most significant effect of traffic volume in both Residential and Rural Residential streets is **loss of amenity due to noise**, as the acceptable limit for noise amenity is well below the physical capacity from traffic engineering considerations.

For Residential streets the recommendations of these Guidelines are 3000 vpd maximum, 2000 vpd desirable, as the "**Environmental Capacity**" traffic volume criteria (Section 2.2).

While traffic **volume** is the major factor in the severity of the noise problem, traffic speed, proportion of heavy vehicles, and the street grade are other factors affecting noise generation.

The severity of the noise impact on residents is a function of the **distance** from the carriageway to the house, as well as the design of the house, type of fencing, and intervening landscaping.

The following Table gives an indication of the required distance from the kerb to the front of the house, for various Design Speeds and Traffic Volumes, for an acceptable noise level at the house.

DISTANCE KERB TO HOUSE FOR ACCEPTABLE NOISE LEVEL

DESIGN SPEED (km/h)	TRAFFIC VOLUME (vpd) 3000	4000	5000
30	7	9	11
40	9	11	13
50	11	13	15
60	13	16	19

Assumes Noise level at house 58dB(A)
Heavy vehicles 5%
Street grade 5%
(Steeper grades require specific assessment)
Based on Background data for AMCORD
Pak-Poy and Kneebone

TABLE 8.5.A

In Rural Residential development the typical carriageway to house distances are greater than conventional residential development, as

- Verge widths are generally greater, and
- Set-backs of houses from the street boundary are generally greater.

Verge widths in Rural Residential development will typically be **7m to 9m**, assuming a reserve width of 20-25m, and a carriageway width of 6 or 7m. However "meandering" of the carriageway may result in a local verge width of perhaps 5m.

House set-backs vary greatly, from a minimum of 6m where topographic constraints apply (eg, a street along a ridgetop), to 100m or more in open country. However a setback of less than **10m** is unusual except where there is a severe topographic constraint.

From Table 8.5.A, for a "worst case" of kerb to house distance of 11m, the maximum acceptable traffic volumes for the recommended Design Speeds are approximately:-

- Access System (45 km/h) 3500 vpd
- Collector System (60 km/h) 2400 vpd

There is no likelihood of such a traffic volume being attained on the **Access System**, as the travel distance criteria will limit the traffic catchment to below the equivalent 350 lots.

However where the traffic catchment on a **Collector Street** exceeds 240 lots, consideration must be given to ensuring an appropriate minimum kerb-to-house distance. This is most readily attained by increasing the street reserve width.

Based on the data referenced in Table 8.5.A, for a centrally-located carriageway 7.5m wide, the reserve width required for a given traffic catchment with a minimum (6.0m) house set-back, would be in accordance with Table 8.5.B.

COLLECTOR STREETS
Reserve Width / Traffic Catchment

Traffic Catchment (lots)	Reserve Width (m)
300	22
350	25
400	28
450	31
500	34

TABLE 8.5.B

Where the carriageway is **not** centrally located, the minimum verge width for a 6.0m house set-back should be in accordance with Table 8.5.C.

COLLECTOR STREETS
Minimum Verge Width

Traffic Catchment (Lots)	Verge Width (m)
300	7.0
350	8.5
400	10.0
450	11.5
500	13.0

TABLE 8.5.C

A further alternative could be to ensure an appropriately greater house set-back than the normal 6.0m by registration of an easement over the allotments. However this approach is unlikely to be acceptable to the developer.

The recommended reserve and verge widths above are based on generalised data, but in most developments the land required for the extra reserve width is unlikely to be sufficiently significant to warrant a more detailed investigation.

However a more exact assessment of site specific noise attenuation requirements may well justify provision of lesser widths in particular cases.

TRAFFIC VOLUME

OBJECTIVES

- To provide acceptable levels of access safety and convenience for all street users, while ensuring acceptable levels of amenity, and protection from the impact of traffic. (AMCORD 01, page 46).
- To avoid streets within any residential neighbourhood from operating as through traffic routes for externally generated traffic (AMCORD 010, page 46).

PERFORMANCE CRITERIA

- The design features of each type of street to convey its primary function and encourage appropriate driver behaviour (AMCORD P4, page 48).
- Street layout which provides that no dwelling fronts a street which carries an unacceptable volume of traffic.
- Street layout which provides that a maximum percentage of dwellings front streets which carry a minimum volume of traffic.
- House site locations to be controlled such that traffic noise generation at the potential house site does not exceed an acceptable level.

ACCEPTABLE SOLUTIONS

- Street layout which positively excludes through traffic.
- Traffic volumes to be calculated in accordance with criteria in Section 8.5 (10 trips/lot/day).
- Acceptable noise levels at potential house sites to be assessed in accordance with Table 8.5.A.

- Traffic catchments not to exceed 350 lots for Access Streets, or 240 lots for Collector Streets unless the street reserve and verges are widened in accordance with Tables 8.5.B and 8.5.C.

PARKING DEMAND

One of the major differences in the characteristics of Rural Residential streets compared to conventional Residential streets is the on-street parking demand - in Rural Residential streets, the demand is **virtually nil.**

PARKING SURVEY RESULTS

A recent survey of the occurrence of on-street parking in Rural Residential developments in Albert Shire provided the following results:-

- On-carriageway parking:
  1 vehicle per 113 lots

- On-verge parking:
  1 vehicle per 24 lots

Approximately 50% of on-carriageway parking was within cul-de-sac turning areas, where narrow frontages or access strips to rear lots limited the availability of on-allotment parking.

When such cul-de-sac parking is discounted, the incidence of on-carriageway parking equates to about **one vehicle per 5km** of street length.

The very low incidence of total street parking can be attributed to the combination of high on-site parking capacity provided by larger allotment areas, and the generally greater walking distance from street to house due to greater verge widths and greater set-back of dwellings.

The high ratio of verge parking to carriageway parking probably results from the combination of perceived narrow carriageway width, and the parking opportunity offered by relatively wide verge widths (typically 6m or 7m), with little formal landscaping to inhibit parking.

DESIGN CONCLUSIONS

From the survey results above, the following conclusions may be drawn:-

- The very low incidence of **on-carriageway** parking which might occur is quite insignificant from traffic considerations, and hence carriageways may be designed on the basis of the **total width being available for moving traffic.**

- The low incidence of **verge parking** which occurs is considered to be **quite acceptable** in principle in this type of development, as there tends to be little formal landscaping on the verges, and with the large frontages any parking is unlikely to occur on neighbours' verges.

- The provision of occasional **indented parking bays** as an alternative to verge parking is likely to be **impractical** due to the large lot frontages and consequent walking distances.

- However parking bays may be warranted at **cul-de-sac heads**, as in Residential streets, if narrow lot frontages and steep topography inhibit on-allotment parking.

VERGE PARKING

To allow for the very low incidence of informal parking on the verge, the standard cross-section of the verge should provide a **2.5m wide strip**, at maximum crossfall 1 in 8, immediately behind the kerb.

However as the incidence of parking is very intermittent, this strip need not necessarily be continuous for the full length of the street, where removal of significant vegetation or major earthworks would be required.

PARKING

OBJECTIVES

- To provide sufficient and convenient parking for residents, visitors and service vehicles (AMCORD 01, page 34).
- To ensure that parked vehicles do not obstruct the passage of vehicles on the carriageway or create traffic hazards (AMCORD 02, page 34).

PERFORMANCE CRITERIA

- Provision for informal parking within the verge area.
- Provision of formal parking bays in areas of higher parking demand (eg, cul-de-sac heads).

ACCEPTABLE SOLUTIONS

- Verge cross-section providing for a strip of land 2.5m wide, with maximum crossfall 1 in 8, behind the kerb of all streets.
- Provision of constructed parking bays adjacent to cul-de-sac turning areas, where topography or allotment layout inhibits parking within allotments.

CONSTRUCTION STANDARD

If the philosophy of "nil future capital cost and minimum future maintenance cost" is accepted (see Section 8.1), **concrete kerb and channel** (or concrete edge strip where appropriate), is virtually a mandatory requirement, to obviate the otherwise on-going cost of maintaining pavement edges, shoulders, and drainage swales.

The recommendations herein are therefore based upon the assumption that standard **"Drive Over" type concrete kerb and channel is provided**, except in the following cases:-

- **High side of one-way crossfall streets** where a standard concrete kerb only, or a concrete flush edge strip, may be used.

- **No Upstream Catchment** - In some situations, where there is no flow from upstream onto the street (eg, along a ridgeline) the use of a concrete edge strip rather than kerb and channel may be appropriate (see Section 8.10).

However, it is recognised that some Councils may allow the **swale drain** option, rather than kerb and channel, to provide a more "Rural" environment, particularly where allotments are relatively large.

CARRIAGEWAY WIDTH

Carriageway width as specified is measured between the bases of the sloping kerb faces - ie, to the invert of the channel for integral kerb and channel, or to the inner edge of kerb only. In the case of flush concrete edge strips measurement is also to the inner edge.

NUMBER OF LANES

From Section 8.6 no provision need be made for on-carriageway parking, and hence the carriageway width need be sufficient **only for moving traffic**.

The options are therefore:-

- **Two Lanes**
- **One Lane** (plus occasional passing bays)

TWO - LANE CARRIAGEWAY

CAPACITY

The **traffic capacity** of a two-lane **Rural** road is typically in the range of 5000 to 7000 vpd (AUSTROADS "Roadway Capacity" - 1988, for "Rolling" to "Level" terrain, and Level of Service "C"). For a two-lane **Urban** road, with no parking, the capacity may be of the order of 10,000 to 15,000 vpd (eg Trunk Collector and Sub-Arterial roads, Sections 3.7 and 6.4).

For **Rural Residential** conditions, with negligible parking, the traffic capacity of a two-lane road may reasonably be assumed to be somewhere between the Rural and Urban capacity ranges, perhaps **8000 to 10,000 vpd.**

This traffic capacity is well in excess of the traffic volume acceptable from noise amenity considerations, ie the **Environmental Capacity,** which is identified in Section 8.5 as being normally within the range of **3500 to 5000 vpd.**

Hence a Two-Lane Carriageway is appropriate for any Rural Residential street.

WIDTH

The appropriate carriageway width will be dependent on the Design Maximum Speed and the Traffic Volume.

For an **Access Place or Access Street**, with a Design Speed of 45 km/h, and low traffic volume, Figure 2.6.F indicates 6.0 or 6.5m as being appropriate for the normal situation of a car passing a moving car.

As **6.0m** has proved satisfactory for this type of street over many years experience, this is the recommended carriageway width.

For a **Collector Street**, with a Design Speed of 60 km/h, extrapolation of Table 2.6.F would indicate a width of 7.0m being adequate for a car passing a moving car.

However, as Collector Streets may be bus routes, and to provide some additional width for stormwater capacity on the higher speed street, **7.5m** is considered to be the preferred width. This width is also consistent with AUSTROADS standards, providing for two lanes of approximately 3.5m, clear of the channels.

Widening should be applied on sharp curves, in accordance with Section 2.10.

CROSSFALL

Access Place and Access Street carriageways may be either one-way crossfall, or two-way crossfall with centre crown.

Collector Street preferred cross-section is two-way crossfall with centre crown.

ONE - LANE CARRIAGEWAY

The Single-lane carriageway with designed passing bays has been identified in Section 2.6 as a possible option for low volume Residential streets. However it has not proved popular in practice, due to:-

- Perceived market resistance

- Need to provide additional parking bays complicates design and construction, and negates any real cost saving from reduction in total paved area.

The Single-lane configuration may, however, warrant consideration for low volume Rural Residential streets (ie Access Places) on the grounds of:-

- **Safety**
  The concept provides an automatic reduction in traffic speed due to the expectation of the need to give way to opposing vehicles.

- **Convenience**
  Though obviously not as convenient for drivers as a continuous unobstructed two-lane carriageway, the much lower traffic volume per length of street means that the number of occasions of meeting opposing vehicles, and hence potential delay, is much less than for Residential streets.

- **Amenity**
  Narrower formation width reduces tree-clearing requirement, and also reduces earthworks and improves allotment access on side slopes.

- **Economy**
  The reduction in pavement construction (typically 2.5m width) over virtually the whole street length can be quite significant, and although the Planning Philosophy may not rate economy a high consideration, this saving can offset a higher construction standard elsewhere, eg, pavement thickness, drainage standards.

PASSING BAY SPACING

The spacing of passing bays should be:

- **Intervisible** so that a driver may see that the carriageway is clear to the next bay. This will vary with topography and vegetation.

- **Sufficiently close** that a driver can recognise the action of an opposing vehicle in the vicinity of the next bay, ie waiting or continuing, **say 100 metres.**

- **Such that the delay in waiting** for an opposing vehicle is acceptable (100m is considered to be reasonable).

PASSING BAY DESIGN

Passing bays should be designed to also act as "**slow points**", to ensure that a driver slows sufficiently to assess that the street section to the next passing bay is clear of traffic, before entering that section.

The "**Central Median**" type device is particularly appropriate for this situation, as

- It controls traffic speed
- It provides passing facility, without encouraging parking, as a simple widening may.
- The lateral deflection of a vehicle is visible at a distance, indicating from the other end of a section that a vehicle is waiting.
- With substantial landscaping, it is readily visible at a distance, both as a speed control, and indicating passing bay location. The "island" may be made quite large, to incorporate existing trees.

From Table 2.3.D, devices with a design speed of 30 km/h and spacing of 100m will result in a **Design Maximum Speed of 45 km/h.** This is consistent with the recommendations of Section 8.4 for Access Streets. A combination of 25 km/h device speed and 120m spacing would be a reasonable alternative, resulting in the same Design Speed.

DESIGN LIMITATIONS

Limits to the application of the "single-lane" concept are:-

- **Acceptable maximum travel time** in the low-speed environment.
- **Acceptable delay** due to giving way to opposing traffic.

A reasonable maximum travel time in the "give-way" situation is considered to be **60 seconds.** Adopting conservative assumptions for acceptable delays, recommended limitations are:-

- **Maximum Travel Distance 500m**
- **Maximum Traffic Catchment 30 lots**

WIDTH

An appropriate width for the single-lane carriageway, with a Design Speed of 45 km/h, is considered to be **3.5m** (Table 2.6.F), given the low incidence of cyclists in Rural Residential areas, and the possibility of parking on a wider carriageway (eg 4.0m).

On sharp curves, carriageway **widening** should be provided, such that a standard HRV tracks on the surfaced pavement. The required widening will be a function of both the curve radius and the deflection angle.

CROSSFALL

Single-lane carriageways will appropriately have a **one-way crossfall.**

DESIGN EXAMPLES

Typical Cross-Sections for the various Street Classifications are shown in Figure 8.11.B, and typical street layout configurations in Figure 8.11.C.

CARRIAGEWAY

OBJECTIVES

- Carriageway width to be sufficient to enable the street to perform its required traffic function efficiently, safely and conveniently, but in the interests of economy to be no greater than necessary for this purpose.
- Carriageway construction standard to minimise both capital cost and future maintenance costs.

PERFORMANCE CRITERIA

- Carriageway widths sufficient for a moving car to pass a moving car, at the applicable street Design Speed, with abnormal movements possible at reduced speed.
- Alternatively where appropriate, design for a single moving lane with passing places at convenient spacings.
- Carriageway cross-section to minimise future edge and/ or shoulder maintenance costs.

ACCEPTABLE SOLUTIONS

- Provision of "Drive-Over Type" concrete kerb and channel (or concrete kerb only or edge strip where appropriate) on all streets.
- Carriageway widths (measured between channel inverts) as follows:-

Access Place (Single lane)	3.5m
Access Place (Two lane)	6.0m
Access Street	6.0m
Collector Street	7.5m

- Design Criteria for all streets in accordance with the provisions of Section 8.7.
- Carriageway cross-sections in accordance with Figure 8.11.B.

FUNCTIONS OF THE VERGE

The Verge on Rural Residential Streets fulfils the same functions as detailed for Residential streets in Section 2.8, although the significance and requirements for these functions may differ.

- **Safety Visibility**
  Slightly higher design speed warrants increased verge width for safety visibility, although the lesser frequency of parked vehicles and high fences also improves visibility.

- **Parking**
  Informal provision for verge parking is necessary in the form of a relatively level strip behind the kerb. However, this strip need not necessarily be continuous full length (see Section 8.6).

- **Landscaping**
  Space for landscaping, and retention of existing vegetation is very important for visual amenity, and to preserve the atmosphere of a "Rural" environment.

- **Utility Services**
  Major service installations will very rarely be required in Rural Residential streets and normal reticulation services can usually be located within standard reserve widths. The major impact may be the necessary removal of vegetation. However, every effort should be made to limit such removal, eg by location of services in the "informal parking" strip adjacent to the kerb, rather than in the more conventional alignment adjacent to the reserve boundary, where the existing vegetation is significant.

- **Changes in Level**
  While vehicular access to allotments is still essential, at a desirable maximum grade of 1 in 6, absolute maximum 1 in 4, the greater allotment frontages, verge widths and house site setbacks make this requirement easier to satisfy.

  On steep side-slopes, additional verge width may be required to accommodate necessary earthworks batters.

- **Pathways**
  The much greater travel distances reduce the incidence of pedestrians and cyclists, and only rarely will Pedestrian / Cycle pathways be required. However, provision for Pony Trails may be a requirement. In such cases additional verge width may be necessary.

- **Buffer Area**
  While standard verge widths and minimum building setbacks normally provide adequate noise buffering, in some cases the combination of higher traffic speed and volume may require additional verge width on Collector Streets (see Section 8.5).

MINIMUM VERGE WIDTH

Verge width may not be constant throughout the street length, as the carriageway alignment may "meander" within the reserve, for improved appearance and / or to minimise earthworks or clearing of vegetation.

The reasonable **absolute minimum** verge width (ie channel invert to Reserve boundary) to satisfy the above criteria is considered to be **5.0m at any point.**

However additional verge width may be required in specific cases, to satisfy the verge functions as discussed above.

VERGE

OBJECTIVES

- To provide a buffer area between the street carriageway and the Rural Residential allotments sufficient for the functions of Safety, Amenity and Convenience, but in the interest of Economy of no greater width than necessary.

PERFORMANCE CRITERIA

Verge width adequate for:-

- Safety Visibility
- Informal parking
- Landscaping for amenity and rural environment
- Preservation of existing vegetation
- Utility services
- Allotment access
- Pedestrian, cycle and equestrian movement
- Noise reduction and buffering

ACCEPTABLE SOLUTIONS

- Absolute minimum verge width of 5.0m at any point.

- Minimum width of 2.5m, with maximum crossfall of 1 in 8, behind the kerb over the majority of the street length, for informal parking.

- Vehicular access to each allotment at a desirable maximum grade of 1 in 6.

- Additional width as necessary to fulfil Performance Criteria.

GENERAL

Typically, **20m** has been the minimum street reserve width for Rural Residential development to date, and this is considered to be a generally appropriate **minimum reserve width.**

Compared to Residential streets, the extra width is justified on the grounds of:-

- Land is less valuable, and particularly where lot yield is based on the gross area of the land, there is little penalty in providing the wider reserve

- Visual amenity is improved, the greater width between boundaries being appropriate to the more rural environment

- Greater opportunity to retain existing vegetation within the street reserve, particularly if electricity and telecom services are underground rather than overhead.

However additional Reserve width may be required, either locally or for the full street length, to satisfy Verge Function criteria as discussed in Section 8.8. The most likely situations requiring additional reserve width are:-

- **Sound attenuation**, on Collector Streets with a traffic catchment exceeding 240 lots (see Section 8.5).

- **Heavy earthworks**

- **Pony Trail** provision.

- **Road Network Planning** may indicate possible future upgrading requirements. However, allowing direct frontage of allotments would need to be assessed in the light of any such possibility.

STREET RESERVE WIDTH

OBJECTIVES

- To provide an appropriate street reserve width to accommodate the required carriageway, and to provide for verges either side of sufficient width to satisfactorily fulfil the required verge functions.

- In the interests of economy, street reserve width to be no greater than reasonably necessary.

PERFORMANCE CRITERIA

- General minimum street reserve width to be sufficient to provide some variation in carriageway location within the reserve.

- Minimum street reserve width at any point to be not less than the sum of the minimum widths required for the Carriageway and the Verge, as identified in Sections 8.7 and 8.8.

ACCEPTABLE SOLUTIONS

- Minimum Reserve Width at any point - **20m**

- Additional width as necessary to fulfil Performance Criteria.

OTHER DESIGN ASPECTS 8.10

GENERAL

Design requirements for other aspects of Rural Residential streets are generally in accordance with the relevant provisions for Residential streets, unless otherwise noted.

GEOMETRIC DESIGN

The following design elements are to be in accordance with the **Residential** street provisions, as detailed in **Section 2.10**, but using the relevant **Design Maximum Speeds** of Section 8.4, ie 45 km/h for Access Places and Access Streets, and 60 km/h for Collector Streets.

- **Sight Distance**
- **Horizontal Alignment**
- **Grades**
- **Vertical Alignment**
- **Crossfall**

INTERSECTIONS

Location, type, and detailed design is to be generally in accordance with **Section 2.11**.

Where **roundabouts** are not required to have a speed-limiting function, design will appropriately be to normal AUSTROADS standard.

TURNING AREAS

Since land area will not usually be a significant constraint, and as cul-de-sacs may be of considerable length, the appropriate turning area may generally be the "**Circular Head**" type. Detailed design of Turning Areas is to conform with **Section 2.12** and Commentary.

SPEED CONTROL DEVICES

Design of Speed Control Devices is to conform generally with **Section 2.13** and Commentary.

However a slight "freeing up" of the geometry will be appropriate in most cases, increasing the transit speed from the normal 20 km/h to (say) 25 or 30 km/h. The "**Street Length**" must then be adjusted appropriately, in accordance with **Table 2.3.D**.

STORMWATER DRAINAGE

Detailed stormwater drainage design should conform generally with the recommendations of the "Queensland Urban Drainage Manual" (QUDM), considering both Access and Collector Streets as "**Minor Roads**".

Relating QUDM recommendations to the **channel lip**, rather than the top of the kerb, to allow for possible amendment to the standard kerb and channel profile, as recommended in Section 5.1 Commentary, appropriate carriageway flow limits for a **Minor Storm** (2 year ARI) in the recommended cross-sections are:-

- **Collector Street** (Centre Crown)
  Zero depth at the crown, or 115mm flow depth at the channel lip, whichever is the lower level (dependent on crossfall).

- **Access Street** (One-Way Crossfall)
  Maximum flow depth 115mm at low side channel lip.

All other requirements for the **Minor Storm, and all Major Storm criteria**, should be generally in accordance with QUDM, noting particularly that where properties are below the street level the minimum verge level should provide a **minimum freeboard of 50mm above the Major Storm level.** However the much larger catchment areas in Rural Residential developments may require some modification of these criteria in some cases.

OTHER DESIGN ASPECTS

OBJECTIVES

PERFORMANCE CRITERIA

ACCEPTABLE SOLUTIONS

As for the relevant provisions of Sections 2.10, 2.11, 2.12 and 2.13 unless otherwise noted in Section 8.10.

EDGE STRIP

In some situations, where there is no flow from upstream onto the street (eg, along a ridgeline) the use of a concrete edge strip rather than kerb and channel will avoid the collection and concentration of the stormwater runoff from the carriageway itself, which otherwise may be difficult to convey to an acceptable point of discharge.

FLOOD ACCESS

The accessibility of a Rural Residential development in time of flood may be a source of resident complaint, and may require future major capital expenditure by the Local Government to upgrade, if not initially constructed to an acceptable standard.

The flood immunity of major cross-road drainage structures should therefore be carefully considered, from Safety, Convenience and Economy considerations.

STREET LIGHTING

Street lighting should be provided to all intersections, speed control devices, sharp bends, or other traffic hazards, generally in accordance with the criteria of Australian Standard AS.1158 "Code of Practice for Public Lighting - Part 1".

However lighting intermediate between these locations may vary dependent on the policy of the Local Government.

ACCEPTABLE SOLUTIONS 8.11

SUMMARY

A summary of "Acceptable Solutions" criteria, as identified in the previous sections of the Guidelines, is provided in Table 8.11.A.

DESIGN EXAMPLES

Typical Cross-Sections for the various Street Classifications are shown in Figure 8.11.B, and typical street configurations in Figure 8.11.C.

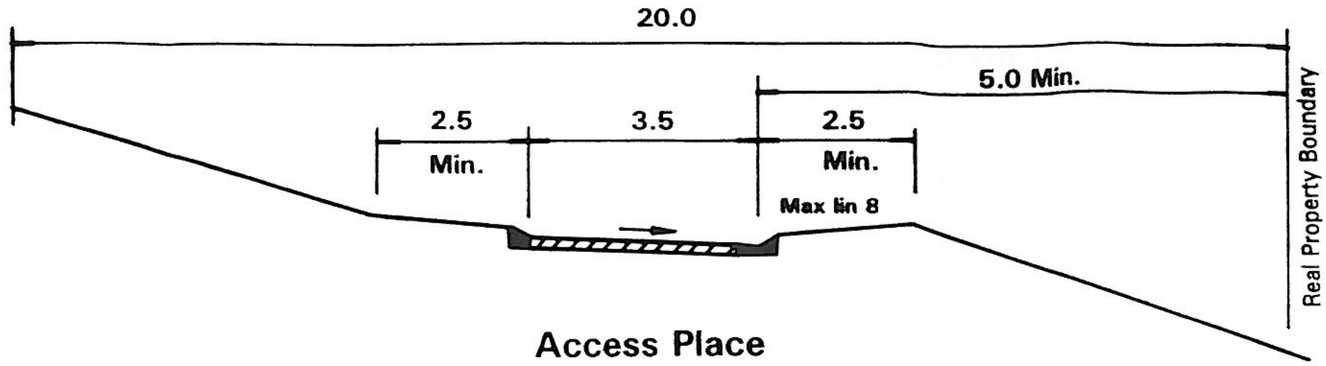
RURAL RESIDENTIAL STREETS
SUMMARY OF "ACCEPTABLE SOLUTIONS" CRITERIA

		Access Place (i) and Access Street (i)	Collector Street
Traffic Catchment	- max	- (ii)	240 lots (iii)
Street Length	- max	1200m (iv)	800m (iv) (2000 total)
Design Speed	- max	45 km/h	60 km/h
Carriageway	- Lanes - Width	2 (v) 6.0m (v)	2 7.5 m
Verge Width	- min	5m	5m
Reserve Width	- min	20m	20m (iii)
Kerbing		Driveover Type	Driveover Type
Parking		No provision (vi)	No provision
Foot/Cycle Paths/ Pony Trails		No provision (vii)	No provision (vii)
Grade	- max - min	16% (viii) 0.3%	16% (viii) 0.3%
Sight Distance	- min	70m	110m
Carriageway Crossfall	- Type - max - min	One-way 1:25 1:40	Centre crown 1:25 1:40

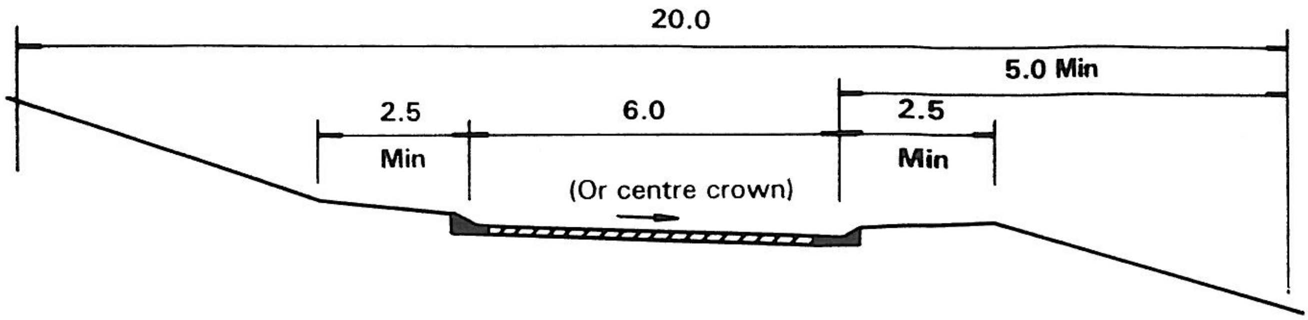
Notes:

(i) Difference is in subdivision layout only, not in street design.
(ii) Theoretical limit based on traffic noise is 350 lots, but Maximum Street Length will normally be the practical limitation.
(iii) May be increased by widening Reserve.
(iv) Maximum street lengths are inter-dependent. Essential criterion is maximum total travel time 180 seconds.
(v) Single lane, 3.5m width, max. 30 lots, alternative for Access Place.
(vi) Parking bays may be required at cul-de-sac heads.
(vii) May be required by Network Planning.
(viii) Absolute maximum 20% under special circumstances.

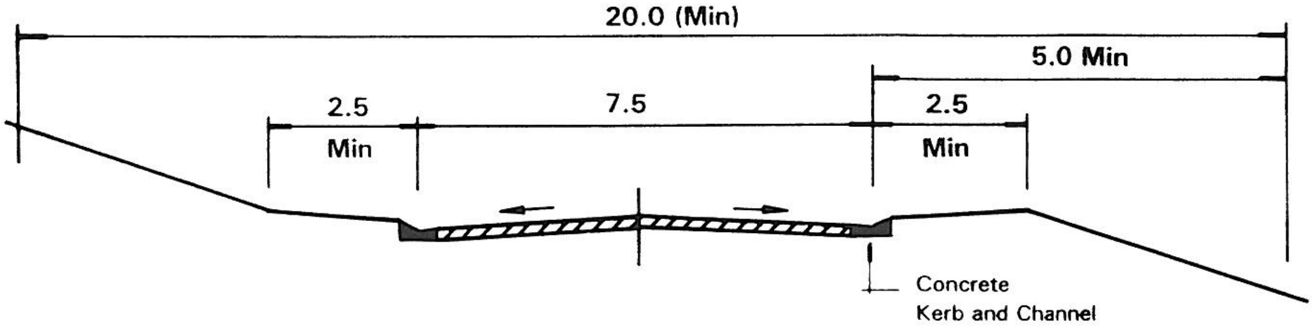
TABLE 8.11.A



Access Place
(One Lane)



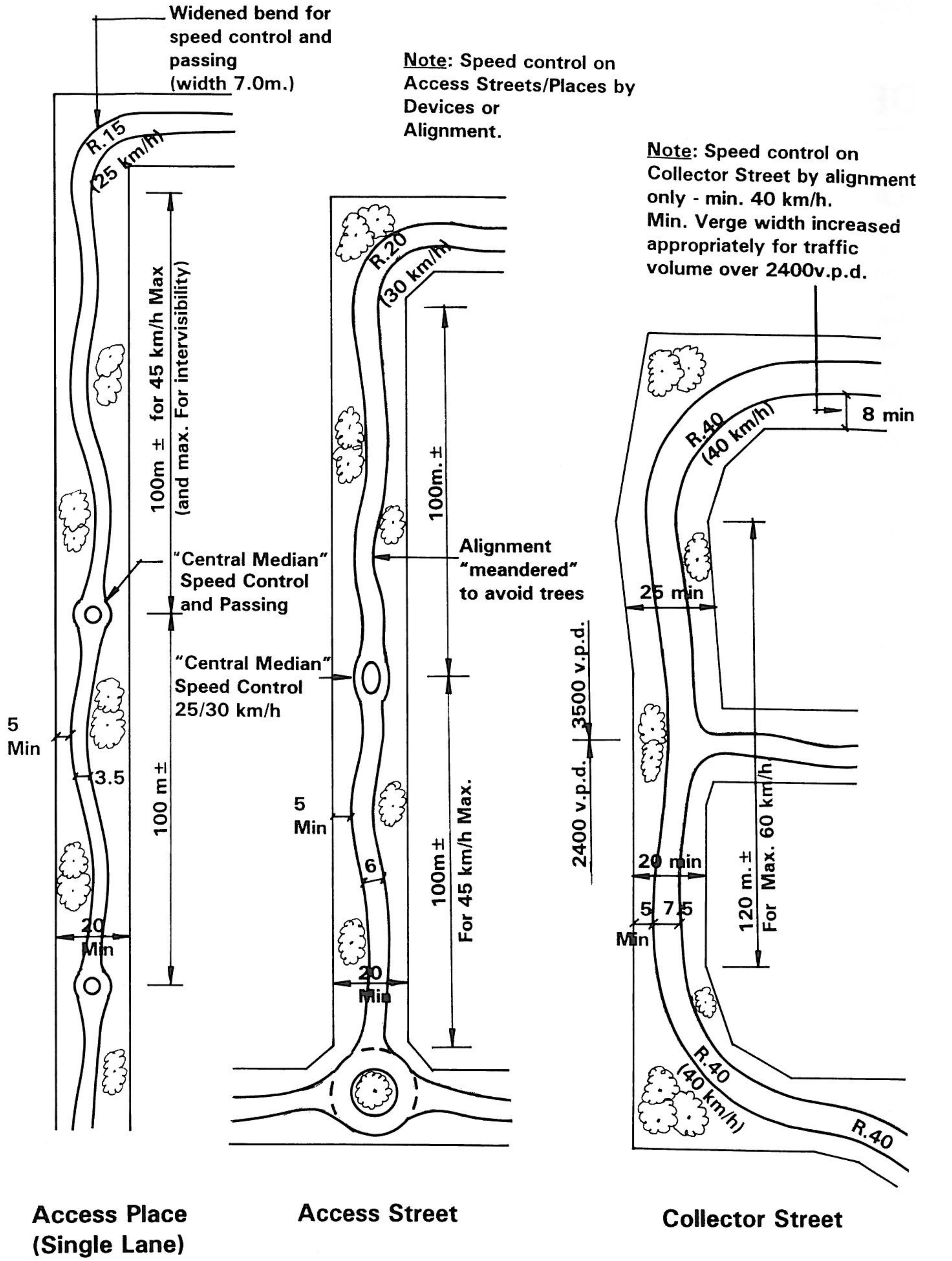
Access Place (Two Lane)
or Access Street



Collector Street

RURAL RESIDENTIAL STREETS TYPICAL CROSS - SECTIONS

FIGURE 8.11.B



RURAL RESIDENTIAL STREETS TYPICAL STREET CONFIGURATIONS

FIGURE 8.11.C

PLANNING FACTORS

As previously mentioned in Section 8.1 the planning policy of excluding from Rural Residential development land suitable for urban use, viable Agriculture, or of Environmental significance implies that future Rural Residential subdivision may be largely on land of marginal topographic useability.

Significant factors to be taken into account in the street and allotment layout of a development will include:-

ENVIRONMENTAL

- **Environmentally Significant Areas:** Preserve as open space.

- **Hazardous Areas:** Flooding, bushfires, slips, contaminated land.

- **Visual Amenity:** Street location and house site location to minimise earthworks and clearing of vegetation.

- **Adjacent Land Uses:** (eg Quarries or Industrial) Buffering may be required

TOPOGRAPHY

- **Street Grading:** Desirable maximum grade 16%, absolute maximum 20%.

- **Side Slopes:** Practical cross-section, retaining structures, slope stability.

- **Allotment Access**, and access to useable house site: 25% maximum access grades.

- **Drainage:** Major waterways.

In general, the **Environmental** issues will identify land to be excluded from development, and perhaps the general form of development, while the **Topographic** issues will dictate the more detailed development form.

DEVELOPMENT FORM

Existing Rural Residential layout tends to be of definite "**branching**" form, mainly cul-de-sacs off a Collector Street, with "looping" of streets tending to occur only in relatively flat country. This layout form is often dictated by topography, the streets following ridge tops and/ or gullies, but probably also results from avoidance of the additional"redundant" street length necessary to complete a loop, the extra length being more significant than in Residential development due to the much larger lot dimensions.

For Future Developments, Environmental constraints may result in more future street location in gullies, rather than on ridge tops, from considerations of visual amenity, and in heavily vegetated areas possible bushfire hazard.

The "Branching" form of layout is consistent with the design principles of these guidelines, having the advantages of:-

- **Excluding any risk of through traffic** in Access Streets and Access Places.

- **Enabling confident assessment of traffic volumes.**

However, in bushfire risk areas the provision for emergency access and escape routes needs to be considered (see below).

The ideals are to:-

- **Maximise the number of short cul-de-sacs,** so that the maximum possible number of lots have minimum passing traffic volume.

- **Minimise the travel distances** from the heads of catchments to the Connecting Roads.

- **Provide emergency route** connections where appropriate.

The Maximum Catchment Length of streets with frontage access, based on the recommended maximum travel times in Section 8.4 is:-

Access Place/ Street	**120 sec**	**1200m**
Collector Street	**60 sec**	**800m**
	180 sec	**2000m**

If the travel distance in the lower class streets is reduced, the total catchment distance can be increased. However this should not be done at the expense of the ideal of "maximum lots with minimum traffic".

Examination of existing development layouts suggest that it will be only in the largest developments that the maximum total street length limits will be reached.

Interconnection between cul-de-sac heads is less important than in residential subdivision due to the reduced emphasis on pedestrian and cyclist traffic. However, such connections in the form of pathways or park strips may be utilised as recreational walking, cycling or horse riding trails, particularly if connecting to Open Space areas, or forming part of an Open Space circuit.

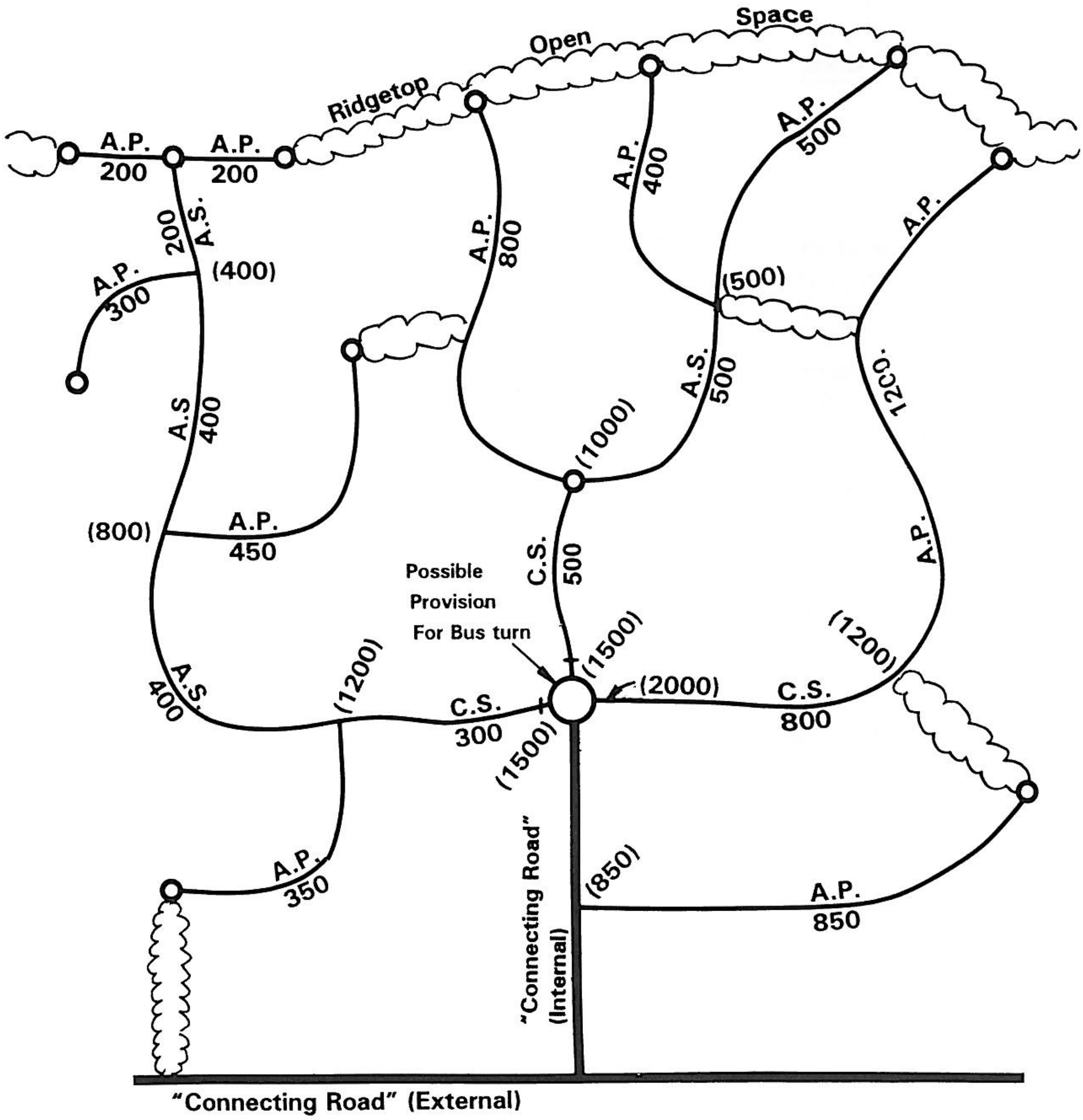
They may also be suitable for **emergency vehicle routes**, eg for firefighting vehicle access and resident evacuation, in bushfire emergencies.

The appropriate construction standard will depend on location and topography, and vehicular access other than in emergencies will generally need to be controlled.

Bus Routes are unlikely to be a factor in street layout, as the low density of development will normally preclude economic provision of a bus route within a Rural Residential development.

However, the possibility of future bus routes, particularly school buses, should be considered on Connecting Roads, and perhaps into larger developments, in which case a looped Collector Road system may be appropriate. A further future possibility could be the use of small buses within the Collector and Access Streets, but such vehicles should require no special design consideration.

A **schematic development layout**, based on the principles discussed above is shown in **Figure 8.12.A.**



"Connecting Road" (External)

No Scale

C.S. - Collector Street (Max.2000m total)
A.S. - Access Street (Max. 1200m)
A.P. - Access Place

500 - Length of Street section

(1200) - Distance from Top of Catchment

- Open Space Links (Available for Emergency Routes)

RURAL RESIDENTIAL DEVELOPMENT SCHEMATIC LAYOUT

FIGURE 8.12.A

SECTION 9.0 - INDUSTRIAL STREETS

QUEENSLAND STREETS

DEFINITIONS

"**Industrial Streets**" are streets in Industrial Zones, which may serve both a **traffic route** function, and also provide **access** to frontage Industrial allotments.

"**Industrial Zones**" may differ in nomenclature dependent on the Local Government Planning Scheme, but typically include designations such as:

- Light Industry
- Medium Industry
- Heavy Industry
- General Industry
- Service Industry
- Hazardous and/or Noxious Industry

ALLOTMENTS

Industrial allotment dimensions may vary greatly, dependent on Local Government by-law provision, market demands, and the requirements of particular industries.

However, in general, the range may be upward from a **minimum area of 1500m² to 2000m²**, with a minimum frontage of about 25m for Light or Service Industry, to an area of **several hectares** and frontage of several hundred metres for particular General or Heavy Industries.

APPLICATION OF GUIDELINES

In general, the recommendations in these guidelines should be applicable to **most urban Industrial** development, except where allotments are **very large** (e.g. frontages over 100m), in which case a **Rural type road** design may be appropriate.

DESIGN PHILOSOPHY 9.2

GOAL AND OBJECTIVES

As for Residential streets, the **Goal** for Industrial Street standards is selection of design criteria which provide the **Optimum Combination of the Objectives** of:-

- **Safety**
- **Amenity**
- **Convenience**
- **Economy**

While the basic philosophy remains the same, the physical variations between Residential Streets and Industrial Streets are such that the optimum solution will in most cases be different.

SIGNIFICANT CHARACTERISTICS

Typical characteristics of the Industrial environment which are significant in determining street design criteria are:-

- **Mixed Functions.** The street provides for moving traffic, vehicles accessing allotments, and parked vehicles.

- **Heavy Vehicles** comprise a relatively high percentage of total traffic.

- **Parking Demand** on the street is usually high.

- **Traffic Speed** tends to be controlled by heavy vehicle movement, and the "friction" of accessing and parking vehicles.

- **Noise Amenity** is not a significant issue in street design, due to the nature of the area.

- **Operating Hours** are normally business hours on weekdays only. Traffic outside these hours is virtually nil.

DESIGN PRINCIPLES

From the above characteristics, the following **Design Principles** may be assumed:

- Design must provide satisfactorily for **moving vehicles, access to / from allotments, and on-street parking.**

- Design geometry should be based on appropriate **heavy vehicles.**

- **Minimum Speed Design** is the appropriate design basis, as speed restriction from consideration of frontage lot safety and amenity is not a significant factor.

Using a nomenclature similar to that for Residential streets, the following classification for Industrial Streets is recommended:

- **Industrial Access Street**
- **Industrial Collector Street**

As discussed in Section 9.7, the distinction between the **Access Street** and the **Collector Street** is rather arbitrary, as both have a similar cross-section, with two moving lanes, and a parking lane each side.

However as the traffic volume increases there is an increase in the significance of the **traffic function** of the street, from the Access Street to the Collector Street, and this is reflected in the:-

- **Greater carriageway width** of the Collector Street;

- **Higher standard alignment** of the Collector Street, necessary to carry a substantial traffic volume, whereas the Access Street alignment is largely dictated by allotment configuration (e.g. 90° bends).

At the point where the capacity of the Collector Street is exceeded, frontage of allotments is no longer permissible, and the road must be a **Major Road** (see Section 6.0), the Classification depending on traffic volume, either a **Sub-Arterial** or **Arterial Road** cross-section being generally appropriate.

TRAFFIC GENERATION

Traffic generation from Industrial development may vary greatly, depending on such factors as:-

- Type of industry
- Size of individual industries
- Amount of retailing
- Proximity to public transport

GENERATION DATA

A summary of available traffic generation data quoted in a draft "Transport Assessment Guide" by the Queensland Department of Transport is:-

	Peak Rate	Daily Rate	Source
Factories	1.0	5	RTA
Large Factories	N/A	4-5	QT
Warehouses	0.5	4	RTA
Warehouses	1.1	N/A	BCC
Light Industry	0.9	9	QT

Rates are Vehicle Trips per **100m² of Gross Floor Area.**

Based on this data, the Department's suggested generation rates per 100m² GFA are:-

	Peak Rate trips/hr	Daily Rate trips/day
Light Industry	0.9	9
Medium to Heavy Industry	0.5	5

For subdivision design, the GFA is not known, and hence generation rates related to gross site area are required. Allowing for normal parking, manoeuvring and landscaping requirements, the GFA for industrial areas is typically about 45% of the site area for light industry and 55% for warehousing or heavy industry, and the above suggested generation rates therefore convert to the following **"trips per hectare"**:-

	Peak Rate	Daily Rate
Light Industry	**40 trips/ hr**	**400 trips/ day**
Medium to Heavy Industry	**28 trips/ hr**	**275 trips/ day**

TRAFFIC COUNTS

For comparison, limited traffic counts on some areas of small-lot Light/Service/Retail Warehouse type industry in Pine Rivers Shire gave the following results:

- Peak Rate - 24 trips/ha/hour (split 60% : 40%)
- Daily Rate - 220 trips/ha/day
- Traffic Composition - 80% Light (e.g. car, van)
  16% Medium (rigid truck)
  4% Heavy (articulated truck)

Converting these counts to "Equivalent Passenger Car Units" (PCU) on the basis of a Medium Truck being 2 PCU and a Heavy Truck 3 PCU, rates are:-

- **Peak** - **30** trips/ha/hour (split 18 : 12)
- **Daily** - **273** trips/ha/day

These rates would approximate to the **"Maximum Day of an Average Week"**, and **"Per hectare"** refers to the total area of industrial allotments in the catchment, i.e. it does not include roads, parks etc.

The subdivisions were fairly typical of the mix of uses commonly found in such industrial areas throughout Queensland, other than those containing larger manufacturing or transport industries.

A single day count in the Sumner Park industrial area in Brisbane City yielded very similar generation rates,

- **Peak** - **18** P.C.U. trips/ha/hour In Major Direction only
- **Daily** - **267** P.C.U.trips/ha/day

COMPARISON

The Pine Rivers and Brisbane City counts agree closely with the Q.T. suggested rates for Medium to Heavy industry, rather than with the rates for Light Industry, to which classification the subject catchments more appropriately conformed.

However this could be attributed to the short duration of the counts; the large number of small individual premises in the count areas, thereby tending to spread the peak; and the amount of retail warehousing, again spreading traffic volume over the day. The retail traffic volume could also account for the direction split in the peak hour being relatively unpronounced (60 : 40).

DESIGN GENERATION RATES

Local traffic counts from existing similar development should be used for traffic volume predictions wherever available, and where specific future uses are known (e.g. a particular large manufacturing plant), appropriate generation rates for that use or uses should be applied.

However, in default of such availability, the following rates, based upon the above data, are suggested as being conservative:

- **Daily Rate - 400 v.p.d. per hectare**
- **Peak Hour - 40 v.p.h. per hectare split 67% : 33% i.e. 27 : 13 v.p.h.**
- **Composition - 20% heavy vehicles**

ASSESSMENT OF TRAFFIC VOLUME

Traffic Catchment assessment must include not only the area of the subject development, but any likely future extensions or connection streets to serve possible development of adjoining lands, in accordance with the Council's Strategic Planning.

Where the traffic catchments are finite, i.e. there is no through traffic route either existing, or created by the new street system, the traffic volumes on the new streets may usually be calculated by the method of Section 2.2 of these Guidelines, and the generation rates quoted above.

However, where there is a **through traffic route,** assessment of the resultant traffic volume will generally require the input of a specialist **Traffic Engineer.**

TRAFFIC CATCHMENTS

COLLECTOR STREET

The maximum acceptable traffic catchment for a Collector Street is determined by the **traffic generation**, per hectare, of the traffic catchment, and the **traffic capacity** of the Collector Street cross-section (one travel lane each way, with a parking lane each side).

The **Street Capacity** will vary with a number of site specific factors, as well as the standard cross-section, such as grades, alignment, intersections, access and parking friction. Given these variables, and the possibility of occasional higher generating land uses and short period peak flows, capacity allowances must necessarily be conservative, suggested capacity limits being in the order of:-

- **Daily** - 12,000 v.p.d. (both ways)
- **Peak Hour** - 800 v.p.h. (one way)

From comparison with the Generation Rates above, the Traffic Catchment limits would be:-

- **Daily Volume** - 30.0 ha
- **Peak Hour Volume** - 29.6 ha

Maximum traffic catchment for general design purposes is therefore recommended as:-

- **30 ha**

However, considering the necessarily conservative assumptions in the above, it is reasonable for Local Government to consider submissions by professional Traffic Engineers for the use of larger Traffic Catchment areas in particular circumstances.

For example, for the specific developments quoted above traffic catchment limits of 40 to 50 ha could be justified.

ACCESS STREET

The maximum catchment for an **Access Street** will be dictated by **Convenience** rather than traffic capacity, due to the more restrictive operating conditions in the narrower carriageway, and necessarily more tortuous alignment to conform to allotment layout (e.g. 90° bends).

While quite arbitrary, it is suggested that an appropriate limit could be:-

- **8 to 10 hectares.**

TRAFFIC VOLUME

OBJECTIVES

- To provide for movement and access, with acceptable levels of Safety and Convenience, for all street users.

PERFORMANCE CRITERIA

- Street layout which restricts the traffic volume on each street to a limit appropriate to the street classification.

- Street layout which excludes unplanned through traffic.

ACCEPTABLE SOLUTIONS

- Traffic volumes calculated in accordance with the Generation rates in Section 9.4, and the methods of Section 2.2

- Traffic catchments not exceeding:-

Access Street	-	**8 ha**
Collector Street	-	**30 ha**

DESIGN SPEED 9.5

DEFINITION

A selected **Design Speed** provides the basis for consistent design of all the geometric elements which comprise the road geometry, e.g. Horizontal Alignment, Vertical Alignment, Sight Distance, etc.

In the case of **Industrial Streets** the Design Speed is a design **Minimum** speed, as conventionally used in road design, **not** a design **Maximum** speed as used for speed-restrictive Residential Street design.

SPEED PHILOSOPHY

Use of the design **Minimum** speed, rather than a design **Maximum** speed and Speed Restrictive Design, is based on the following considerations:-

- During normal operating hours traffic speed is usually effectively controlled by **heavy vehicle movements**, and the "friction" caused by accessing and parking. Outside normal hours traffic volume is so low that there is little potential problem.
- **Noise amenity** from traffic speed is not a significant issue, in view of the industrial activities of the area.
- **Speed control devices** which can control heavy vehicle speed with reasonable convenience are virtually ineffective for light vehicles.

DESIGN SPEEDS

The recommended standard **Minimum Design Speed** for all Industrial Streets is:-

- **60 km/h.**

However, this Design Speed may be varied in the following circumstances:-

- A **Higher Design Speed** should be used for all streets where the "**speed environment**" is such that vehicle speeds are likely to routinely exceed the standard design speed, e.g. at the end of a long level straight length of street a curve should appropriately be of greater radius than that required for the standard minimum design speed.
- A **Lower Design Speed** may be approved in special cases at the Council's discretion, e.g. difficult topography.
- A **Lower Design Speed** may be used on an **Access Street** in the case of a horizontal alignment necessary to provide a reasonable allotment layout (e.g. bends of approximately 90°).

  The appropriate Design Speed in such a case should, where possible, be based on the **Speed Environment** as assessed from the horizontal alignment (see Section 9.10).

  The **Horizontal Alignment** should be the limiting factor in all cases where the design speed used is less than standard, i.e. vertical alignment and sight-distance criteria should be appropriate for a speed equal to or greater than that for the horizontal alignment. This is because horizontal alignment is much more apparent to a driver than vertical alignment and sight distance limitations.

DESIGN SPEED

OBJECTIVES

- To provide a street environment which allows all street users to travel, park and access allotments with Safety and Convenience.

PERFORMANCE CRITERIA

- Street geometry based on an appropriate **Design Minimum Speed.**

ACCEPTABLE SOLUTIONS

- Standard Design Minimum Speed on all Industrial streets to be **60 km/h.**
- A higher Design Speed to be used where the **"speed environment"** is substantially higher than 60 km/h.
- A lower Design Speed being acceptable on **Access Streets** in special circumstances, with a minimum Design Speed of 30 km/h.

PARKING DEMAND

Even with the typical Town Planning requirements for provision of a reasonable number of parking spaces within the allotments, existing industrial estates show a generally **high demand** for on-street parking, with the great majority of parked vehicles being light vehicles, rather than trucks.

Some allotment parking space tends with time to be alienated for other uses, e.g. storage or display, and visitors may be reluctant to drive into allotments, particularly where parking spaces are not readily visible from the street, due to perceived congestion and fear of vehicle damage.

PARKING PROVISION

Hence a parking lane should in general be provided on **both sides of all Industrial Streets.**

The only likely exceptions may be:-

- Adjacent to **Open Space areas** of considerable extent;
- Adjacent to **very large industrial sites** where buildings are well set back, a high level of on-site parking is provided, and the boundary is security fenced;
- **At sharp bends**, where parking may be deleted on the inside of the bend, to improve sight distance.

PARKING

OBJECTIVES

- To provide sufficient and convenient parking for employees, visitors, and commercial vehicles.
- To ensure that parked vehicles do not obstruct the passage of vehicles on the carriageway, or create traffic hazards.

PERFORMANCE CRITERIA

- Provision of a Parking Lane on the carriageway of all Industrial Streets, where there is adjacent frontage of Industrial allotments.

ACCEPTABLE SOLUTIONS

- Parking lanes on both sides of the carriageway of all Industrial streets, except in the cases listed in Section 9.6
- Parking lane widths in accordance with Section 9.7.

DRAINAGE METHOD

The high incidence of on-carriageway parking, and vehicle movements to and from properties, requires provision of **concrete kerb and channel** to protect the pavement edges and to minimise maintenance requirements.

The recommended profile is the **Barrier type Kerb and Channel** - (AS 2876 - 1987, Figure 1). This profile is preferred as:-

- It helps to **inhibit parking** on the verge, which should not be necessary with continuous parking lane provision;

- Construction of standard **Industrial crossings** to properties generally **requires full replacement** of the existing kerb and channel, thereby negating the usual benefit of the "Driveover" profile.

Detailed drainage design should be in accordance with the recommendations of **QUDM**.

NUMBER OF LANES

From previous discussion, the following conclusions may be drawn:-

- **Facility of Vehicle Movement** requires a minimum of two lanes (one each way) for moving traffic.

- **Parking** demand requires provision of a parking lane each side of every street which provides property access.

- When the traffic volume reaches the **capacity limit** for one lane each way, two lanes each way could theoretically be provided. However, a Central Median is generally not practical, as discussed below, which would necessitate a carriageway width of approximately 20m for four moving lanes, with a parking lane both sides. Such a width is considered excessive from aesthetic considerations, and heavy vehicles turning across two moving traffic lanes to access properties would be undesirable.

Hence the standard lane provision for **all Industrial Streets is two Moving Lanes, with a Parking Lane each side.**

As stated in Section 9.3, when the traffic capacity of such a cross-section is exceeded frontage of allotments is no longer acceptable and the road will be a "No-Access" Road, either a **Sub-Arterial** or **Arterial Road.**

LANE WIDTHS

MOVING LANES

Given the high percentage of heavy vehicles and frequent turning movements to access properties, the recommended width for moving lanes is:-

- **All Streets - 3.5m**

PARKING LANES

Again, the higher percentage of heavy vehicles requires generous parking lane widths, particularly with the use of upright kerb profile.

The higher traffic volume on **Collector Streets** indicates the desirability of a greater parking lane width, to:

- **Minimise the "friction"** of parked vehicles on moving traffic;

- **Assist turning into allotment driveways** without crossing the carriageway centreline;

- **Provide sufficient width for an auxiliary turning lane** at intersections, without additional carriageway widening;

- **Provide width for cyclists** on the carriageway, where a cycle path is not provided.

Recommended **Parking Lane** widths are therefore:

- **Access Streets** 2.5m
- **Collector Streets** 3.5m

CARRIAGEWAY WIDTHS

From the above, the total recommended **Carriageway** widths are:

- **Access Street** 12.0m
- **Collector Street** 14.0m

Widths are measured between the channel inverts.

CENTRAL MEDIAN

As referred to above, while provision of a central median could be desirable, from both traffic and aesthetic considerations, allotment access requirements will normally make a **median impractical**. The unknown locations of future allotment entrances, and the length of median breaks required for articulated vehicles, inhibits use of a median with breaks, while a continuous median would require U-turning at intersections. The turning geometry of heavy vehicles is such that a continuous median would generally be acceptable only between roundabouts of appropriate diameter.

However, short **median islands** should be provided at major intersections for traffic control, pedestrian refuge, and possibly for traffic signals. Where a median or median islands are provided, the **minimum width** should be **2.0m.**

CARRIAGEWAY CROSSFALL

The normal standard carriageway crossfall and the **minimum** from surface drainage considerations, is **1 in 40, i.e. 2.5%.**

The **maximum** crossfall should not normally exceed **1 in 33, i.e. 3.0%.**

The **Centre Crown** should be the normal form of carriageway cross-section, but occasionally, use of an **Offset-Crown** section may be appropriate on side-sloping topography. However **stormwater drainage** requires careful consideration to ensure that surface flow across the carriageway does not become a hazard to traffic, and that the flow in the channel on the lower side does not exceed acceptable criteria.

In general, where an offset crown is used the high-side parking lane should fall to the channel on that side.

LANE MARKING

The extent of lane delineation should generally be as follows:-

- **Access Street**
  Normally **no delineation** is required, except at locations such as sharp bends or crests where a separation line (or barrier line) should be provided.

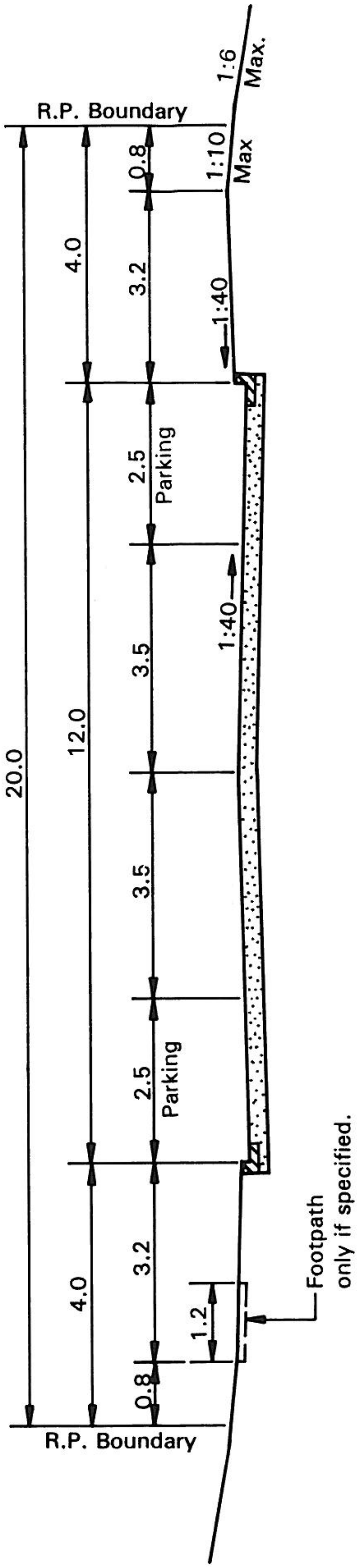
- **Collector Street**
  A **Separation Line** should be provided on the centre line (barrier line where necessary), and an **Edge Line** to delineate the parking lane.

  Marking of individual parking bays is **not** normally practical due to the length variation of vehicles.

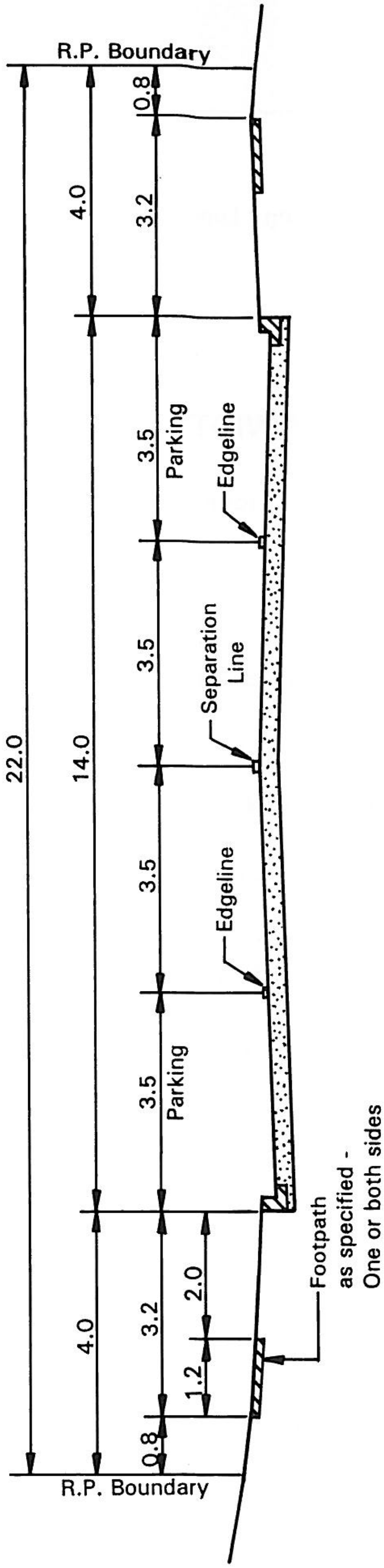
All lane marking should be in accordance with the **"Manual of Uniform Traffic Control Devices"** (Queensland Transport).

STANDARD CROSS-SECTIONS

Standard cross-sections for Industrial Streets are shown in Figure 9.7.A.



INDUSTRIAL ACCESS STREET



INDUSTRIAL COLLECTOR STREET

STANDARD CROSS SECTIONS
INDUSTRIAL STREETS

FIGURE 9.7.A

CARRIAGEWAY

OBJECTIVES

- Carriageway width to be sufficient to enable the street to perform its required traffic and parking functions efficiently, safely and conveniently, but in the interests of economy to be no greater than necessary for these purposes.
- Carriageway construction standard to minimise both capital cost and future maintenance costs.

PERFORMANCE CRITERIA

- Carriageway width providing two lanes for moving traffic (one each way), and a parking lane each side wherever there is frontage of Industrial allotments.
- Lane widths appropriate for the movement and parking of heavy vehicles, and for access to allotments with minimum interference to moving traffic.

ACCEPTABLE SOLUTIONS

- **Lane Widths** as follows:-
  Moving lane (all streets) - 3.5m
  Parking Lane (Access Street) - 2.5m
  (Collector Street) - 3.5m
- **Carriageway widths** as follows:
  Access Street - 12.0m
  Collector Street - 14.0m
- **Carriageway crossfall:**
  Minimum - 1 in 40 (2.5%)
  Maximum - 1 in 33 (3.0%)
- **Kerb and Channel** on all streets to be Barrier Type (AS 2876 - 1987, Figure 1)

FUNCTIONS OF THE VERGE

The Verge on Industrial Streets serves the same functions as for Residential streets, although the significance and requirements for these functions differ markedly.

- **Safety Visibility**
  Provision of a parking lane provides a "buffer width" between the kerb and moving traffic for pedestrians, and for vehicles exiting properties.

  The internal allotment layout should be such that all vehicles exit from properties in a forward direction. Hence the safety visibility for exiting vehicles is controlled by the incidence of parking rather than by verge width.

- **Parking**
  Provision of a parking lane should remove any necessity for vehicles to park on the verge, and the potential damage to kerb and channel and footpath paving by heavy vehicles is such that verge parking should be discouraged.

- **Amenity**
  Landscaping to improve amenity is **highly desirable,** but establishment and maintenance may pose practical problems. Some businesses, particularly those with a retailing function, may be diligent in landscape establishment and maintenance, while others may not.

  Buffering for traffic noise attenuation is not a consideration in industrial areas due to the potentially higher noise generation of the land uses.

- **Utility Services**
  On Collector Streets particularly, provision for major service installations may be required, e.g. trunk water or electricity mains.

- **Changes in Level**
  While Industrial land should be relatively flat, changes in level between the street and the allotments are quite critical for access by heavy vehicles.

  Desirably the **maximum crossfall** on the verge should not exceed **1 in 10** and the **maximum grade** within the allotments **1 in 8.**

- **Pathways**
  The location of industrial development, and degree of public transport provision, is generally such that virtually all travel to and from industrial sites is presently by private vehicle.

  However the use of public transport and pedestrian and cycle travel modes is being actively encouraged in transport strategies, and therefore Industrial Streets should provide appropriately for pedestrian and cycle traffic.

  The verge cross-section of **all** Industrial Streets should allow for possible future **footpath** construction, but in general actual construction will be required on **Collector Streets** only, on one or both sides as nominated by the Council.

  Cycle traffic can generally be accommodated in the extra width of parking lanes on a Collector Street, but in some cases the Local Government Strategy Planning may indicate the need for a Cyclepath or Dual-Use path within the verge. In such a case, **additional verge width** will be required.

MINIMUM VERGE WIDTH

The general **Minimum Verge Width** on all Industrial Streets to provide for the above functions is:-

- **4.0m**

However, additional verge width may be required in special circumstances, e.g. to accommodate trunk services, or a Dual-use path. In the latter case the minimum verge width required is **5.0m.**

VERGE

OBJECTIVES

- To provide a buffer area between the street carriageway and the Industrial allotments sufficient for the functions of Safety, Amenity and Convenience, but in the interests of Economy of no greater width than necessary.

PERFORMANCE CRITERIA

Verge width adequate for:

- Safety visibility
- Amenity
- Utility services
- Pathways

Verge Crossfall suitable for:

- Allotment access
- Pedestrian movement
- Drainage

ACCEPTABLE SOLUTIONS

- **Minimum verge width** at any point - **4.0m**
- **Additional width** as necessary to fulfil Performance Criteria (5.0m minimum if Dual-Use Path required)
- **Verge Cross-Section** in accordance with Figure 2.8.F.
- **Maximum crossfalls**
  Within the verge - **1 in 10**
  Within allotments, adjacent to the verge - **1 in 8**

MINIMUM RESERVE WIDTHS

The minimum reserve width required is the sum of the carriageway width and the verge widths, viz:-

- **Access Street** **20.0 m**
- **Collector Street** **22.0 m**

ADDITIONAL WIDTH

Additional reserve width may however be required in special circumstances such as:-

- **Trunk Services**
- **Cyclepaths**
- **At Major Intersections,** to provide for auxiliary lanes and/or islands.

TYPICAL CROSS-SECTIONS

Typical cross-sections for each class of Industrial Street are shown in Figure 9.7.A.

STREET RESERVE

OBJECTIVES

- To provide an appropriate street reserve width to accommodate the required carriageway, and to provide for verges either side of sufficient width to satisfactorily fulfil the required verge functions.
- In the interest of economy, street reserve width to be no greater than reasonably necessary.

PERFORMANCE CRITERIA

- Minimum street reserve width at any point to be not less than the sum of the minimum widths required for the Carriageway and the Verge, as identified in Sections 9.7 and 9.8.

ACCEPTABLE SOLUTIONS

- **Minimum Street Reserve Width** at any point:

Access Street	-	**20m**
Collector Street	-	**22m**

- **Additional width** as necessary to fulfil Carriageway and verge criteria.

GEOMETRIC ELEMENTS

Geometric design includes a number of inter-related design elements, including:-

- Horizontal Alignment
- Superelevation
- Curve Transition
- Grade
- Sight Distance
- Vertical Alignment

BASIS FOR DESIGN

The geometric design data in this section is based primarily on the recommendations in **AUSTROADS "Rural Road Design - 1989".**

HORIZONTAL ALIGNMENT

DESIGN BASIS

Since the design of Industrial Streets is based on the conventional concept of a **Design Minimum Speed** the limiting factor in horizontal alignment is the **minimum curve radius** appropriate for the selected design speed.

MINIMUM CURVE RADIUS

Minimum curve radii for a given Design Speed are shown in Table 9.10.A. **"Absolute Minimum"** radii are based on "Side Friction" criteria for standard 1 in 40 crossfall, either "favourable" or "adverse" to the direction of curvature. However a truck with a high load may tend to be unstable at these speed/radius combinations, and will appropriately negotiate such a curve at a speed 5 to 10km/h below the Design Speed. The "**Desirable Minimum**" Radii allow such a truck to negotiate the curve at the Design Speed.

For the **Standard Design Speed** of 60 km/h, for all Industrial Streets, the desirable minimum radius is therefore **100m.**

Design Speed (km/h)	Minimum Curve Radius (m) Favourable Crossfall	Minimum Curve Radius (m) Adverse Crossfall	Desirable Minimum Radius (m)
30	19	22	25
35	26	30	35
40	34	39	45
50	53	61	70
60	80	93	**100**

MINIMUM CURVE RADIUS
TABLE 9.10.A

SUPERELEVATION

From the above it is apparent that there is little gained by superelevation on small radius curves, as the additional centreline radius of the outer lanes compensates for the adverse crossfall on those lanes.

Superelevation also introduces potential problems for allotment access and carriageway drainage, and hence will rarely be either necessary or desirable.

If superelevation is used the crossfall should be within normal crossfall limits, i.e. **1 in 40 to 1 in 33**, and application should be in accordance with the recommendations of AUSTROADS "Rural Road Design".

TRANSITION

Plan transition also is not normally required on Industrial streets.

However the application of curve widening to the inside edge of each lane as recommended in "Curve Widening" below provides a transitioning effect to the vehicle path.

CURVE WIDENING

Widening should be applied to all lanes, both moving and parking, on smaller radius curves, to allow for the greater effective carriageway width occupied on a curve by a longer vehicle (e.g. HRV or AV).

Recommended Curve Widening is given in Table 9.10.B.

Curve Radius (m)	Widening Per Lane (m)
25 or less	0.75
25 - 40	0.50
40 - 80	0.25

CURVE WIDENING
TABLE 9.10.B

Widening should be applied to the **inner edge** of each lane. For **short curves** widening is most easily applied by using appropriately larger lane line radii to provide the required widening at the centre of the curve. However for **longer curves,** a uniform increased width may be provided over most of the curve length, transitioned by a larger radius curve at each end.

APPLICATION OF HORIZONTAL ALIGNMENT

Application of the foregoing data may be summarised as follows:

- **Collector Street**
  - Normal configuration will be standard crossfall with **no superelevation or transition.**
  - For standard **60 km/h** design speed, the desirable minimum centreline **radius** will therefore be **100m**, controlled by the adverse crossfall of the outer lane(s) (Table 9.10.A).
  - Curve **widening** will **not** be required for a curve of the desirable minimum radius.
- **Access Street**
  - For **Standard 60 km/h** design speed the design criteria will be as for a Collector Street, above.
  - **For the special case of a sharp bend,** where necessary to provide a reasonable allotment layout, a design speed of minimum **30 km/h** may be used, i.e. a minimum centreline radius of **22m,** provided that there is reasonable approach visibility to the bend.

An indication of the **Speed Environment** adjacent to a bend may be derived from the data in Section 2.3:-

Street Length (m)	Speed Environment (km/h)
45	35
80	40
100	45
120	50
150	60

SPEED ENVIRONMENT
TABLE 9.10.C

From Table 2.3.D, assuming:
"End Condition" average 30 km/h,
"Street Length" as defined in Section 2.3.

Ideally, the Speed Environment adjacent to a sharp bend of less than standard radius should be as low as possible, by limiting the "Street Length" of the approaches to the bend. However, as Table 9.10.C illustrates, it may often be impractical to achieve a Speed Environment less than the standard 60km/h Design Speed.

As a **minimum requirement Stopping Sight Distance for the approach Speed Environment,** should be provided on the approaches to the bend. Sight distance should be available in both the horizontal and vertical plane, and the approach geometry should be such that the configuration of the bend is apparent to an approaching driver e.g. **not** on a sharp crest vertical curve.

- **Curve Widening** in accordance with Table 9.10.B should be provided on all lanes, where the radius is 80m or less.

GRADES

The **Maximum** longitudinal grade on any Industrial Street should **desirably** not exceed **6.0%.**

However, where this grade cannot be reasonably attained, the recommended **Absolute Maximum** grades are:-

- **Access Street** 10.0%
- **Collector Street** 8.0%

Approaching an **intersection,** grades should not exceed **3%,** to avoid the risk of high vehicles overturning.

The **Minimum** longitudinal grade, based on drainage requirements, is 0.30%.

SIGHT DISTANCE

While all Industrial streets provide separate moving lanes for each direction of traffic, the potential conflicts from vehicles accessing properties, and on occasion double-parking, are such that the **General Minimum Sight Distance** provided should be **twice the Stopping Distance** for the relevant Design Speed, measured between "eye heights" each 1.15m above the carriageway.

This is the same principle as for Residential streets.

For the Design Speeds appropriate for Industrial Streets required stopping distances and minimum sight distances are:-

Design Speed (km/h)	Stopping Distance (m)	General Minimum Sight Distance (m)
30	20	40
40	30	60
50	40	80
60	**55**	**110**

GENERAL MINIMUM SIGHT DISTANCE
TABLE 9.10.D

Note: 60 km/h is the **Standard Design Speed.** Lesser Design Speeds apply only on Access Streets in special cases.

On sharp **Horizontal Curves** provision of the General Minimum Sight Distance on the inside of the curve should be checked by the method of Section 2.10 (Figure 2.10.B), and if necessary an appropriate truncation of the property boundary provided. Elimination of the parking lane on the inside of the bend is also recommended, to improve visibility.

VERTICAL ALIGNMENT

Criteria for Vertical Alignment for Industrial streets are the same as for Residential streets (Section 2.10) and the Design Graphs in that section may therefore be used, **using the appropriate Design Speed** for the subject Industrial street.

However, the following points should be noted:-

- **Speed Environment**

  Because Industrial streets are not designed on a speed restrictive basis, the actual speed environment may in places exceed the design speed.

As vertical alignment is not nearly as obvious to drivers as the horizontal alignment, vertical alignment should **always** be designed as generously as reasonable, particularly in such situations of higher speed environment.

- **Underpasses**

  The only situation where the greater driver's eye height for trucks (1.8m compared to 1.15m for cars) may be a disadvantage is at underpasses. In such cases sight distance for this greater eye height should be checked.

GEOMETRIC DESIGN

OBJECTIVES

- Geometric Design criteria for the detailed design of the street to provide Safety, Amenity and Convenience for all street users, with maximum consistent Economy of construction and maintenance.

PERFORMANCE CRITERIA

- Design criteria based on an appropriate **Design Minimum Speed.**
- Horizontal and Vertical geometry to provide for consistently safe operation at the Design Speed.
- Grades sufficient for carriageway drainage, but otherwise the minimum possible, for convenient operation.
- All design criteria to be appropriate for heavy vehicle operation.

ACCEPTABLE SOLUTIONS

- **Design Speed** generally **60 km/h,** except where a higher or lower speed is appropriate in accordance with Section 9.10.
- **Horizontal Alignment** in accordance with Table 9.10.A for the appropriate Design Speed.
- **Curve Widening** in accordance with Table 9.10.B.
- **Sight Distance**
  As appropriate for the Design Speed, or higher Speed Environment, in accordance with Table 9.10.D.
- **Maximum Grade** - **6.0%.**
- **Vertical Alignment** in accordance with Section 2.10, for the relevant Design Speed.

LOCATION OF INTERSECTIONS

The general principles of subdivisional layout applicable to intersections are:-

- The total number of intersections should be minimised.
- Desirably, streets should intersect only with streets of the same or next adjacent classification, e.g. an Access Street should desirably **not** intersect with a Major Road.

TYPES OF INTERSECTION

Within Industrial areas, appropriate intersection types are:-

- **'T' Junction** - **Priority controlled, three-way**
- **Roundabout** - **Three or more ways**
- **Signalised** - **Three or four-way**

T-Junctions, with normal priority control will be the most appropriate form of intersection for most intersections of Access Streets and Collector Streets.

Roundabouts require a considerable area to provide the geometry necessary for articulated vehicles, but may be appropriate for 4-way intersections on Collector Streets.

Signalised control may be required for intersections on Collector Streets, or for intersections onto the external Major Road system.

SPACING OF INTERSECTIONS

Intersections should be located sufficiently far apart to:-

- Separate traffic movements at each intersection, and
- Provide a reasonable time interval between driver decisions.

Desirable minimum intersection spacings (centre line to centre line) are:-

	Access Street	Collector Street
• **On same side of through street**	**60m**	**100m**
• **On opposite sides of through street:**		
- Left-Right Stagger	**60m**	**150m**
- Right-Left Stagger	**30m**	**60m**

Subdivision layout constraints may however require some compromise of these ideals.

DESIGN VEHICLE

The Design Vehicle for Industrial Street intersections should be **AUSTROADS Design Semi-Trailer,** turning at radius **15m** (outside front wheel-path).

T - JUNCTIONS

ALIGNMENT

Alignment of the approach streets should be such as to establish without any ambiguity the major street / minor street priority.

The angle between the street centrelines should be **90°**, unless some skewing is essential in which case the **minimum** angle is 70°. The minor street centreline should be straight for a minimum of 20m from the tangent point of the kerb return, to avoid the tendency otherwise for traffic to "cut the corner".

KERB RADIUS

Kerb radii at intersections are controlled by the left-turning movement. Turns between **Access Streets** or between **Access and Collector Streets,** will generally be from the moving lane to the moving lane, the turning path cutting across the parking lanes in each street.

In such a case for a 90° intersection, a **12m Kerb Radius** will provide for a Design Vehicle turn without encroaching over the centreline of either street (see Figure 9.11.A).

For turns between **Collector Streets**, or between a Collector Street and a Major Road, the turn will generally be **from** a left-turn lane against the kerb, **to** the left-hand moving lane in the other street. In these cases a site specific intersection design will be required.

LANE WIDTHS

In consideration of the high percentage of heavy vehicles, **all lanes**, both through and auxiliary (e.g. left turn and right turn) should generally be **3.5m minimum width.**

MEDIAN ISLANDS

Central median islands are desirable to:-

- Separate opposing traffic movements, and
- Provide a refuge for pedestrians crossing higher-volume streets.

Their necessity will depend on the intersection geometry, and vehicular and pedestrian traffic volumes. However as a general guide they will **not** be required at the intersection of two Access Streets, **may** be required at the intersection of an Access Street and a Collector Street, and will **generally** be required at an intersection of two Collector Streets, or at **any signalised** intersection.

DETAILED DESIGN

All design details for T-Junctions should be in accordance with **AUSTROADS "Guide to Traffic Engineering - Part 5 - Intersections at Grade", 1988.**

ROUNDABOUTS

Roundabouts on Industrial Streets differ from those on Residential Streets in that they are designed in accordance with normal roundabout design practice, rather than as Speed Control Devices to restrict street speed.

Hence all detailed design should be in accordance with **AUSTROADS "Guide to Traffic Engineering Practice - Part 6 - Roundabouts", 1993,** using the AUSTROADS "Design Semi-Trailer" as the design Vehicle.

ROAD RESERVE BOUNDARIES

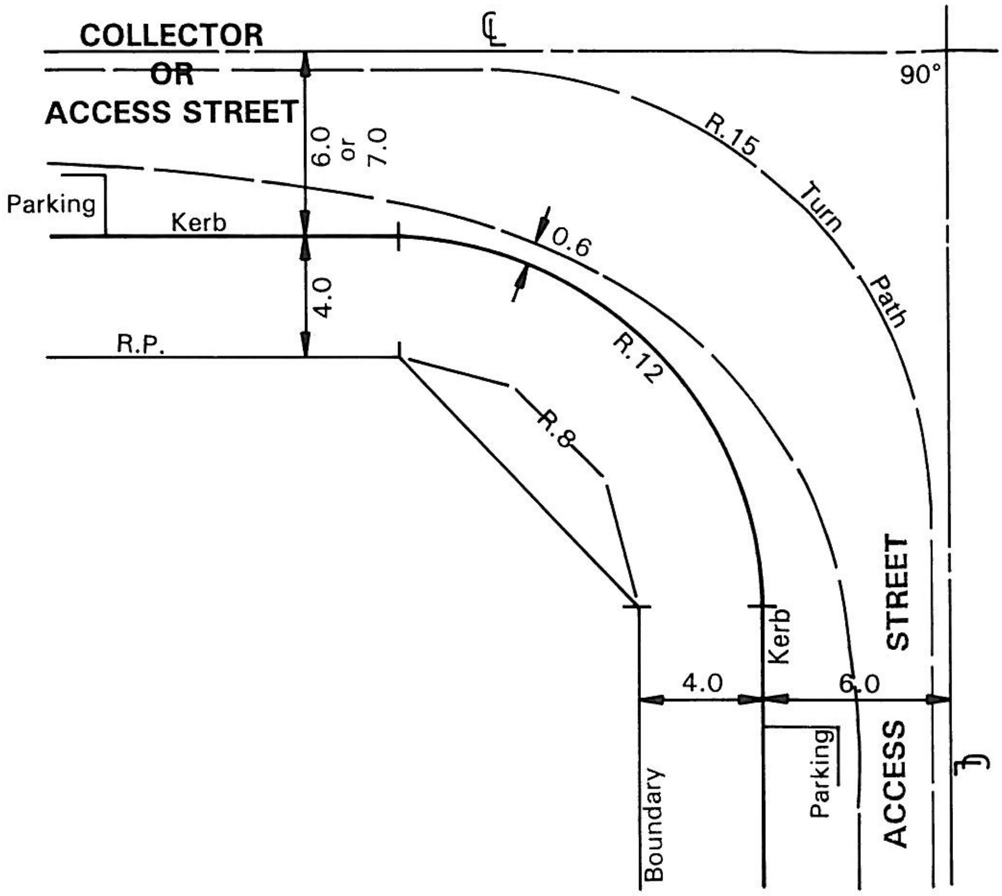
TRUNCATIONS

In general, truncation of the street reserve boundary **will** be required to provide that the verge width around the intersection is not less than the standard verge width. For a T-Junction with 90° intersection angle, straight street alignment and 12m radius circular curve kerb-line, the required truncation is **8m tangent length** along each street boundary. This may be provided either as a single chord, or as a number of chords to a circular arc.

For intersection geometry as above, such a truncation will also satisfy sight distance requirements. However, for other geometry this situation should be checked using the method of the above design references, and additional truncation provided if necessary.

WIDENING

Provision of intersection median islands, and/or carriageway widening for auxiliary lanes, will often require local widening of the street reserve in the vicinity of intersections.



INDUSTRIAL STREETS
TYPICAL INTERSECTION

FIGURE 9.11.A

LINE MARKING AND SIGNAGE

All intersections are to be line marked and signed in accordance with the **"Manual of Uniform Traffic Control Devices".**

LIGHTING

All intersections are required to be effectively lit, generally in accordance with the criteria of Australian Standard **AS.1158 "Code of Practice for Public Lighting - Part 1".**

EXAMPLES

Typical Industrial Street intersection details are shown in **Figure 9.11.A.**

INTERSECTIONS

OBJECTIVES

- To provide intersections between streets with maximum possible safety, and convenience of operation.

PERFORMANCE CRITERIA

- Subdivision design to minimise the total number of intersections.
- Intersections generally only between streets of the same class, or the class immediately above or below.
- Sufficient spacing between intersections to avoid driver confusion.
- Design to reinforce street hierarchy, subdivision legibility, and vehicle priority.
- Adequate approach sight distance.
- Slow speed of negotiation, consistent with convenience.

ACCEPTABLE SOLUTIONS

- Designs in accordance with the principles of Section 9.11, and with relevant AUSTROADS Design Codes.

GENERAL

Facility for vehicles to turn must be provided at the end of all cul-de-sac streets.

In the case of Industrial streets, the necessity to design for heavy vehicles, and the high incidence of parking demand, mean that turning areas require considerable areas of land and carriageway construction, and have great potential for traffic and parking congestion.

Hence the subdivision layout should **use cul-de-sacs only when unavoidable,** and in such cases the cul-de-sac length should be **as short as possible** (see Section 9.14).

TURNING

Traffic volume, high incidence of parking, and heavy vehicle movements in Industrial turning areas are such that the **single-movement turn** is preferable from safety and property damage considerations.

PARKING

The **demand** for parking in cul-de-sac turning areas is generally high, as the restricted allotment frontages tend to inhibit the provision of allotment parking spaces visible from the street.

The **supply** of kerbside parking in the turning area is restricted however, by the relatively high proportion of kerb length taken up by allotment driveways. In some cases this may be such as to completely inhibit parking around the turning area, but generally there will be some **limited scope** for kerbside parking.

Therefore in designing the turning area it must, in general, be assumed that **parking may occur** along the kerb - whether or not signed as "No Standing".

If a central island is provided, parking may possibly also occur against the island kerb, but this is less likely, being an "unnatural" way to park, and since the kerb radii are quite sharp. Parking may also take place on the island itself. For this case, the most practical solution is probably to provide a number of **indented parking bays within the central island,** or elsewhere within the immediate vicinity of the turning area, for smaller vehicles at least.

DESIGN VEHICLE

Turning areas should be designed with geometry to accommodate the **AUSTROADS Design Semi-Trailer,** turning with an outside front wheel path radius of **12.5m**.

Outside overhang should also provide **clearance** for the **AUSTROADS Design Single Unit Truck** (this overhang being greater than for a Semi-Trailer).

DESIGN DETAIL

DESIGN OPTIONS

The two basic design options are:

- **Open Turning Circle**, with no central island
- **Central Island**

Due to the large pavement area of the "Open" circle, the Central Island option is preferable from aesthetic considerations.

KERB RADIUS

For an **"Open Turning Circle"** a kerb radius of **12.5m** is acceptable, as if kerb parking does occur within the circle the unimpeded area allows for a three-point turn movement.

However, where a **Central Island** is provided this is not possible, and the kerb radius must be sufficient to allow for both kerb parking and vehicle turning.

Allowing for outer overhangs, clearances of 0.6m and a parking width of 3.5m (long vehicles on curve), the appropriate **outer kerb radius is 17.5m.**

CENTRAL ISLAND

A central island should allow for the design vehicle turning path, plus a clearance of 0.6m to the kerb line. The shape of the island may not be symmetrical but a "nose" radius of 5.0m will generally be appropriate.

Parking bays within the island should conform with normal standard dimensions, but care is necessary with parking bays on the "departure" side of the island, to ensure practical entry geometry.

APPROACH ALIGNMENT

To allow a design vehicle to follow the design turning path, the approach and departure alignment of the kerb should provide a **straight of minimum 15m** length between the tangent points of the turning area curve and the reverse curves from the standard width carriageway. These entry/exit curves should be not less than **20m radius.**

DESIGN EXAMPLE

Turning area design geometry will often be site-specific. However a design example for a "Central Island", based on the above principles, is shown in **Figure 9.12.A.**

TURNING AREAS

OBJECTIVES

- To provide for the turning of vehicles at the end of cul-de-sac streets, with maximum safety and convenience of operation, at minimum construction cost.

PERFORMANCE CRITERIA

- Subdivision layout to avoid the use of **cul-de-sac streets**, wherever possible.
- In the interests of Safety and Convenience, an area for a **Single Movement** turn to be provided at the end of every cul-de-sac.
- Turning area to accommodate an appropriate Design Vehicle.
- Design to discourage parking where it may impede the turning movement.

ACCEPTABLE SOLUTIONS

- Design using the AUSTROADS Design Semi-Trailer, turning at 12.5m radius, with a Single-Movement turn.
- Design providing for a reasonable level of parking in or adjacent to the turning area.
- Design conforming with the principles of Section 9.12 and Figure 9.12.A.

ACCEPTABLE SOLUTIONS 9.13

SUMMARY

A summary of "Acceptable Solutions" criteria, as identified in the previous sections of the Guidelines, is provided in Table 9.13.A.

TYPICAL CROSS-SECTIONS

Typical Cross-Sections for the recommended Street Classifications are shown in Figure 9.7.A.

INDUSTRIAL STREETS
SUMMARY OF "ACCEPTABLE SOLUTIONS" CRITERIA

	Access Street	Collector Street
Traffic Catchment (max)	8 ha	30 ha
Design Speed	60km/h (i)	60km/h
Carriageway:		
- Moving lanes	2 x 3.5m	2 x 3.5m
- Parking lanes	2 x 2.5m	2 x 3.5m
- Total width	12.0m	14.0m
Verge Width (min)	4.0m	4.0m (ii)
Reserve Width (min)	20.0m	22.0m (ii)
Footpaths	Not required	One Side (iii)
Grade:		
- Desirable Maximum	6%	6%
- Absolute Maximum	10%	8%
- Minimum	0.3%	0.3%
Sight Distance (min)	110m	110m
Carriageway Crossfall	Two Way	Two Way
- Minimum	1:40	1:40
- Maximum	1:33	1:33

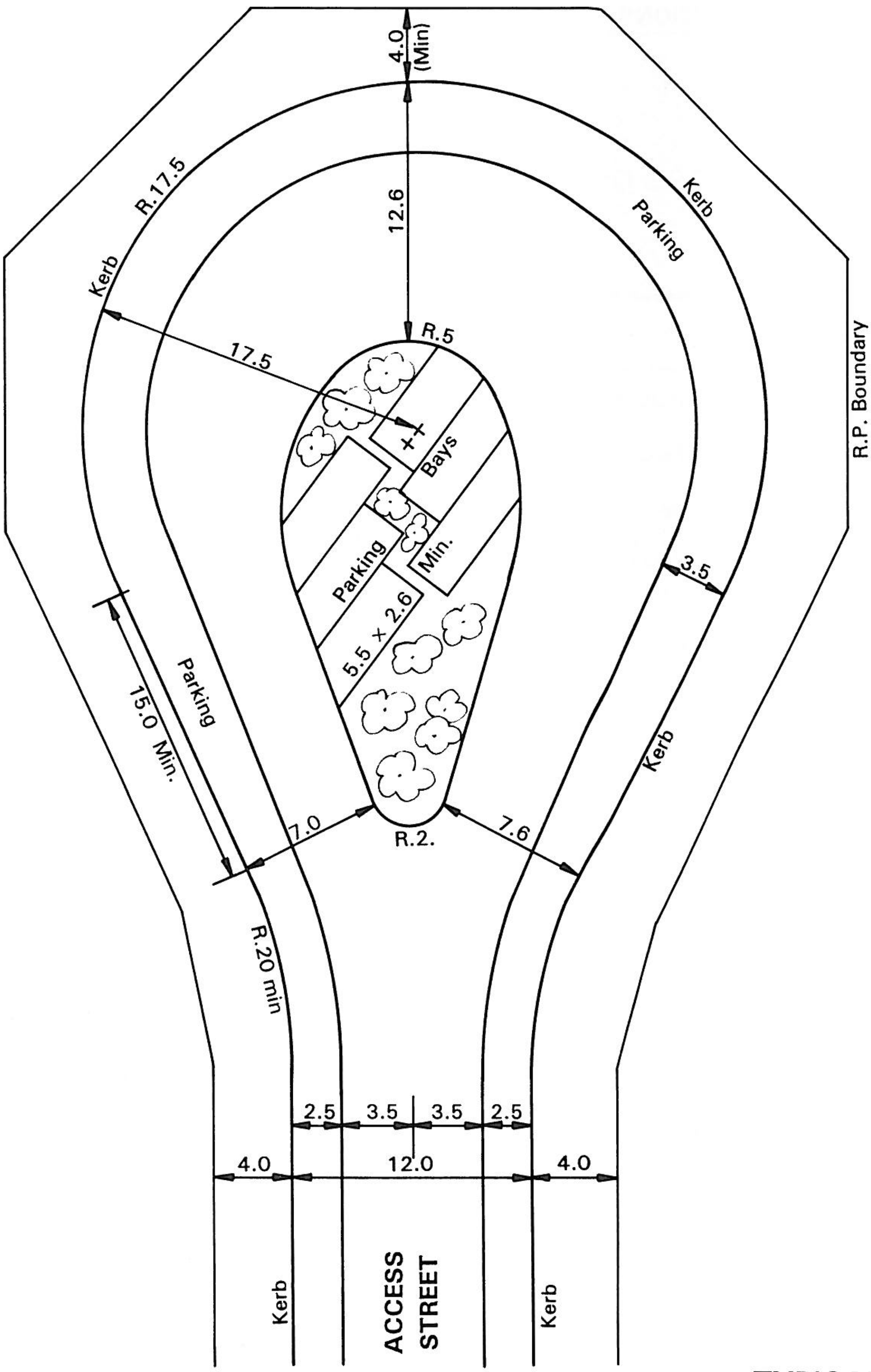
Notes:

(i) May be reduced to 30 km/h in special circumstances. (See Section 9.5).

(ii) Greater width may be required (see Section 9.8).

(iii) Paths may be required both sides, subject to the Council's Pedestrian network design.

TABLE 9.13.A



TYPICAL INDUSTRIAL TURNING AREA

FIGURE 9.12.A

GENERAL

Subdivision layout and street design criteria are mutually interdependent.

Several aspects of this relationship have been referred to previously, but this Section summarises the **street design criteria** which should be considered in the subdivision layout design, and vice versa.

ROAD PATTERN

- **Avoid cul-de-sac streets** if at all possible. Loop streets are much preferable.
- **Minimise the length** of a cul-de-sac, where its use is unavoidable.
- **Minimise Internal Traffic Volumes** where possible, by additional connections to the external road system. Desirably a minimum of two alternative routes should be available, for emergency use (e.g. fire).
- **Avoid Creating Through Traffic** routes which will allow "rat-running" by external traffic.
- **Provide for Bus Routes** within the development, where appropriate.

ROAD LOCATION

- **Alignment** of Collector Streets to be appropriate for design speed.
- **Minimise Road Crossfall,** for allotment access considerations.
- **Sight Distance** appropriate for the design speed should be attainable.

PEDESTRIAN/CYCLE ROUTES

- **Pathway connections** to minimise pedestrian and cyclist travel distances.

INTERSECTIONS

- **External Road Connections** require careful consideration of number and location. This factor may govern the subdivision pattern.
- **Minimise total number** of intersections, subject to reasonable connectivity.
- **Separation distances** between intersections should be adequate (see Section 9.11).
- **Intersection angles** should be approximately 90°.
- **Sight Distances** at intersections should be adequate. Location in a sag is generally preferable.
- **Vehicle Access** must be available to each lot at a satisfactory location.

DRAINAGE

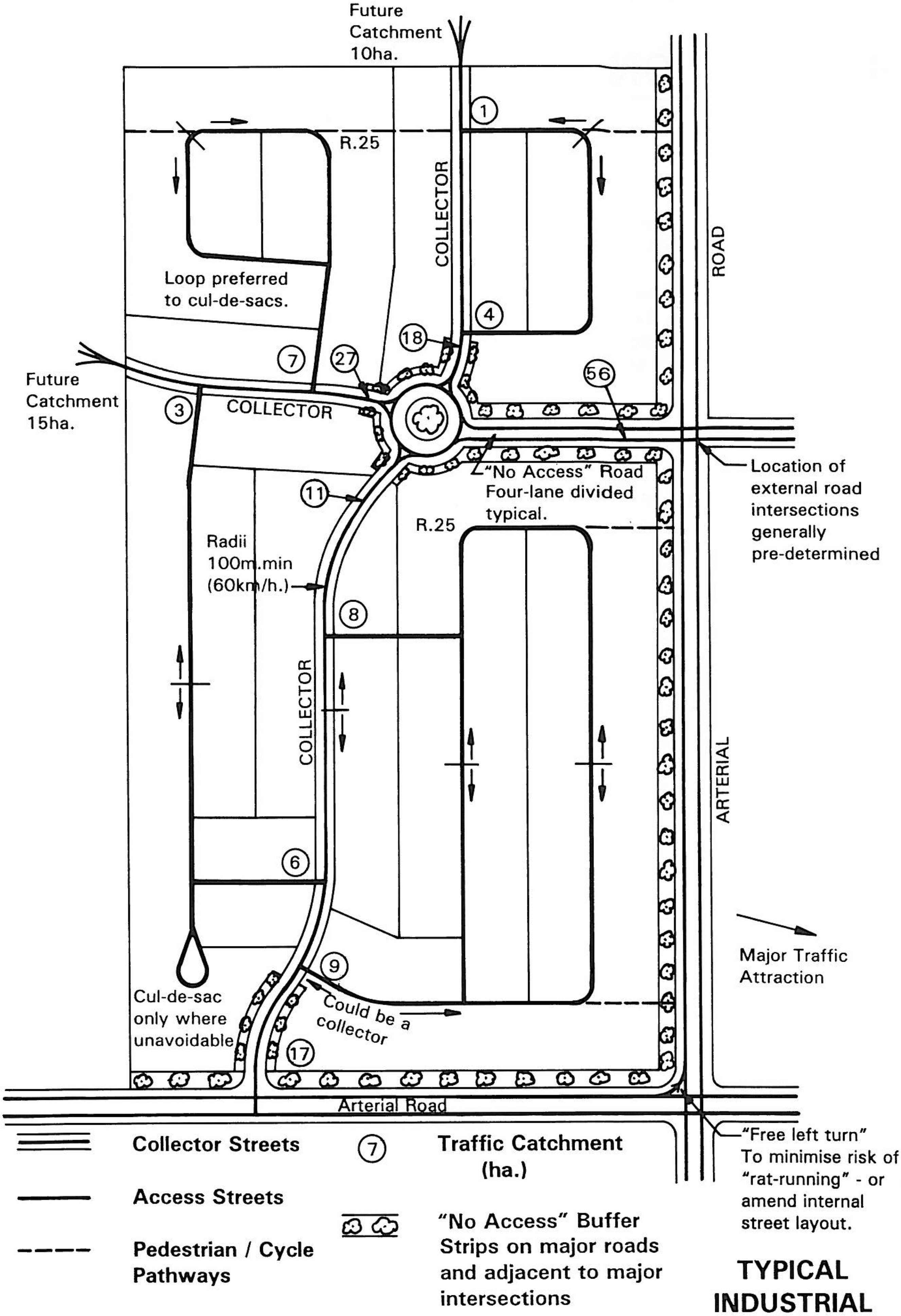
- **Minor Drainage Paths** are best located in streets where practicable.
- **Major Drainage Paths,** where undergrounding is impracticable, should be in separate open-space reserves.

ALLOTMENT LAYOUT

- **Avoid "hatchet" lots** if possible, as they accentuate parking problems on the Access Street.
- **Minimise Cul-de-Sac lots** accessing from the turning area, to reduce parking and traffic congestion in the turning area.

AMENITY

- **Preserve existing vegetation** wherever possible, in islands, medians or park areas.
- **Maximise landscaping opportunities** in medians, cul-de-sac turning islands, etc.



TYPICAL INDUSTRIAL DEVELOPMENT

FIGURE 9.14.A

SECTION 10.0 - MULTI-UNIT RESIDENTIAL STREETS

INTRODUCTION 10.1

DEFINITION

"Multi-Unit Residential Streets" are streets which provide access and local traffic functions for Multi-Unit residential developments.

Multi-Unit residential development in the context of these Guidelines may be defined as **housing with more than two dwelling units on a single site, and having a common driveway access.** A wide variety of housing types may be included, such as detached "group housing", town-houses, unit development, flats and apartments. Building form may be single storey, low-rise, or multi-storey.

APPLICATION

In the past most Multi-Unit development has been by **redevelopment** of lower density Residential areas with **already existing street systems.** However the trend to higher development densities, particularly in community "core" areas, and adjacent to transport facilities, will result in an increasing requirement for the design of **new streets in "greenfield" situations** specifically for Multi-Unit development. The recommendations of this Section are primarily for such applications.

However the recommendations may also be of assistance in the redesign of existing streets where redevelopment to higher densities takes place, and the existing street system must be adapted to the requirements of the higher density.

The likely range of densities for which this Section will be applicable is generally referred to as "**Medium Density**", similar to the density of Brisbane City Council "RB4" zoning, or Residential "B" and "C" in some other Council Planning Schemes . The actual site density range is probably about **25 to 70 residential units per site hectare, i.e. 1 unit per 400m² of site area, to 1 unit per 150m².**

Within this relevant range, the term "lower density" in the text refers to a site density of less than about 1 unit:250m², while "higher density" refers to a site density of about 1 unit:150m².

This density range overlaps some development forms covered by the provisions of **Section 2.0 - Residential Streets,** e.g. small-lot detached dwellings, duplex and terrace housing, with site areas of about 250m² or more, street frontages of about 12m or more, and individual driveway accesses. However it is the **form of development** rather than the actual **site density** which determines the applicable Section of the Guidelines, viz:-

- **Section 2.0** for separate frontages and separate accesses.
- **Section 10.0** for common sites, each with a common access.

GOAL AND OBJECTIVES

As for Residential streets, the **Goal** for Multi-Unit Residential Street standards is the selection of design criteria which provide the **Optimum Combination** of the objectives of:-

- **Safety**
- **Amenity**
- **Convenience**
- **Economy**

Also as for Residential streets, the basic design philosophy is:-

- **Traffic Volume Limitation,** to a limit appropriate to the "Environmental Capacity" of the street, achieved by subdivision layout, and
- **Traffic Speed Limitation,** to a limit consistent with the safety and amenity of street users and residents, achieved by appropriate detailed design of the street geometry.

While the basic philosophy and many of the technical recommendations are the same, the physical variations between conventional Residential and Multi-Unit residential streets are such that the optimum solution is in some cases different.

SIGNIFICANT VARIATIONS

The differences between Multi-Unit Residential Streets and conventional Residential Streets which have most significance in determining design criteria are:-

- **Traffic Volumes are higher.** While traffic generation per residential unit is less than in conventional Residential, the total traffic generation per hectare is greater, due to the greater development density.
- **Street Parking Demand** is generally much more significant. While the demand per unit is typically less, the high development density results in a considerably greater total demand. The demand may also be much more **variable** than for Residential, due to variations in the form and density of development.
- **Street Parking Capacity** per dwelling unit is also more variable, due to greater variability in site frontages and in driveway spacings.
- **Bus Routes** are more economically feasible due to the higher population density, and hence require greater consideration in design.
- **Pedestrian Traffic** volume is greater, due to the higher population density, and generally closer proximity to transport and services, which encourages walking. Typically, the proportion of children may be less, but that of elderly people may be greater.
- **Cycle Traffic** may be comparable to, or less than for Residential, in spite of the greater population density and lesser travel distances, as the proportion of children may well be less.

RESIDENTIAL/MULTI-UNIT INTERFACE

In many cases a Multi-Unit residential area will be essentially isolated from conventional Residential areas, having its own connection(s) to the Major Road system, without street connections between the Multi-Unit and Conventional Residential areas.

However, from consideration of the street design, there is no reason why a Multi-Unit area should not access through a conventional Residential street system, or vice versa, **provided** that the streets are designed for the relevant **total traffic volume.**

In such a situation, it would generally be preferable for **Multi-Unit development to be adjacent to the Major Road system,** i.e. "downstream" of the conventional Residential areas, as:-

- Traffic from a Multi-Unit area through a conventional Residential area is a likely source of complaint, regardless of actual traffic volume.
- Locating higher density development adjacent to Major Roads and other transport facilities minimises traffic volumes on the minor streets, and minimises average travel distances and times.

GENERAL

As discussed for Residential Streets (Section 2.7), while the ideal is for all streets with frontage access to have low design traffic volume and low design traffic speed, subdivision layout necessitates that this ideal must be compromised to some extent in the streets which carry higher traffic volumes.

Hence a "hierarchy" of streets is inevitable.

CLASSIFICATION

For Multi-Unit Residential streets a similar nomenclature to that for Residential streets is adopted, viz:-

- **Access Place**
- **Access Street**
- **Collector Street**
- **Trunk Collector Street**

The subdivision layout characteristics of these street classes may be quite similar to their Residential equivalents. However the different traffic design criteria for Multi-Unit streets result in there being generally much less distinction in geometric design characteristics between classes than is the case for Residential Streets.

Hence the classification may in some aspects be rather arbitrary.

ACCESS PLACE AND ACCESS STREET

As for Residential Streets, the distinction between the Access Place and the Access Street is one of "form" rather than "function", the **Access Place** being a single cul-de-sac, while the **Access Street** is a "stem" from which two or more cul-de-sac streets branch, or a "loop" street.

An Access Street will generally connect to a Collector Street, but may connect to a Trunk Collector Street or occasionally to the Major Road system.

COLLECTOR STREET

The **"Collector Street"** in the Multi-Unit context is by definition an identified **potential bus route,** and it is this factor rather than the subdivision layout form which determines its engineering design criteria, and which distinguishes a Collector Street from an Access Street.

The Collector Street will generally have a number of Access Streets, and possibly Access Places, branching from it. It may connect directly to the Major Road system, or occasionally to a Trunk Collector Street.

TRUNK COLLECTOR STREET

The **Trunk Collector Street** is a Major Street, connecting the Local Street System to the Major Road System.

In the Residential context, the Trunk Collector is a **"no-access street"**, as the traffic volume and speed preclude direct access to conventional residential lots.

However, large **Multi-Unit Residential** developments may access to Trunk Collectors, subject to appropriate detailed design of access and sound attenuation aspects.

GENERATION RATE

Traffic generation from Multi-Unit Residential developments will vary, dependent on the various factors discussed in Section 2.2 for Residential Streets.

However, the variation may be even greater than for conventional Residential areas, given the generally lesser homogeneity in Multi-Unit development, both in dwelling types and in population demography.

Very little local traffic generation data is available for Multi-Unit development. However, the following summaries U.S.A. data from the Institution of Transportation Engineers (1991).

Housing Type	Average Daily Weekday	Average Daily Peak Hour
Family detached	9.6	0.74
Apartment (rental) pre 1973	6.5	0.51
Apartment (rental) post 1973	6.3	0.44
Low rise	6.6	0.47
Townhouse (owner)	5.9	0.44
High rise (10 storeys or more)	4.2	0.30

TRIP ENDS PER DWELLING UNIT
TABLE 10.4.A

Given the good correlation with the accepted Australian generation rate of 10.0 trips per day for detached residential, it is considered reasonable to adopt a **Daily Generation Rate of 6.5 trips per unit** for all types of Multi-Unit development.

However, the peak hour rates appear low by local standards, 1.0 trips/hour being generally accepted for Australian detached residential.

The Multi-Unit maximum hour generation is likely to be if anything proportionately higher than for detached residential, as peak traffic will tend to be more strongly employment oriented, with less of the school and shopping traffic typical of detached residential areas.

Hence **0.65 trips/unit/per hour** is considered a reasonable **Peak Hour** generation rate, with an assumed peak hour 0.45/0.20 direction split.

EFFECT OF PUBLIC TRANSPORT

Although there is no known data to quantify the effect of the availability and proximity of good public transport on Multi-Unit traffic generation, it is reasonable to assume that if convenient public transport is closely available it will result in **reduced car trips**, although from available studies apparently not in car ownership,

In such cases therefore (e.g. within 400m of a suburban railway station) there may be scope for reducing the above generation rates somewhat.

ENVIRONMENTAL CAPACITY

Section 2.2 identifies a traffic volume of **3000 v.p.d.** as the upper limit of acceptability for Residential streets with direct frontage access, based principally on considerations of

- **Traffic noise;**
- **Pedestrian convenience and safety,** crossing the street;
- **Vehicular convenience and safety,** entering and leaving properties.

However the significance of these factors is somewhat modified for Multi-Unit residential development.

NOISE

The slightly increased distance from moving traffic to the property boundary, generally necessary to accommodate the greater parking demand, provides an increased buffering distance, allowing a traffic volume of about **3500 v.p.d.** for the same noise level at a "standard" 6.0m setback as for a 3000 v.p.d. volume on a Residential Collector.

Multi-Unit development can also be **specifically designed and sited**, more readily than conventional detached residential, to reduce traffic noise impact by:-

- Greater setback from the street boundary,
- Building design and construction methods,
- Sound attenuation measures between the street and the building (e.g. mounding, fencing etc).

PEDESTRIANS

The typically higher pedestrian volumes in Multi-Unit residential areas increase the significance of pedestrian **safety and convenience.**

While the proportion of children pedestrians is likely to be generally lower than in conventional Residential areas, there may be an increased tendency for children to play on the street, due to reduced availability of on-site play area. The proportion of elderly pedestrians, possibly physically handicapped, is likely to be greater than in Residential areas, increasing the importance of constructed footpaths and adequate crossing points.

On higher traffic volume streets, pedestrian crossing points should be specifically designed, with reduced vehicle speed and reduced carriageway width, desirably with a central refuge.

As an indication of the significance of increased traffic volume on pedestrian convenience and potential safety, for a crossing width of 6.0m:

Traffic Volume	% of Pedestrians Delayed
3000 v.p.d.	56%
4000 v.p.d.	67
5000 v.p.d.	74
6000 v.p.d.	80

TRAFFIC VOLUME & PEDESTRIAN DELAY
TABLE 10.4.B
(From Holdsworth & Singleton 1979)

VEHICULAR ACCESS

Compared to conventional residential, Multi-Unit development results in a greater number of entrance/exit movements, and parking/unparking movements, for a given street length, with resultant greater potential for loss of **safety** and **convenience** to both the access/parking traffic and the moving traffic.

However, in compensation:-

- Vehicles should be able to both enter and leave the site in the forward direction, for all but the smallest developments.
- Accesses will be located further apart,
- Driveways to larger developments can be designed virtually as intersections, with channelisation, auxiliary lanes, and adequate internal queuing length (e.g. on Trunk Collectors).

DESIGN CRITERIA

While from the above **3000 v.p.d.** (i.e. approximately 450 units catchment) is considered to be a reasonable **Environmental Capacity limit** for Multi-Unit development **without special design**, it is evident that with appropriate detailed design attention to the above issues Multi-Unit development can be satisfactorily allowed to access to streets with **considerably higher traffic volume.**

This is consistent with the recommendations of **Section 3.7,** which recognises the acceptability of access of such developments to **Trunk Collector Streets**, subject to appropriate traffic, parking and noise attenuation design.

ASSESSMENT OF TRAFFIC VOLUME

The assessment of the traffic volume at any point in the street system may be carried out in accordance with the methods of Section 2.2, but using the recommended **Generation Rate of 6.5 trips/unit/day.**

As also detailed in both Section 2.2 and in Section 3.0, the ability to assess the traffic volume with reasonable confidence is dependent on a street layout which either **excludes or positively discourages through traffic**, ensuring that only traffic generated by the relevant catchment uses the subject street.

TRAFFIC VOLUME

OBJECTIVES

- To provide acceptable levels of access safety and convenience for all street users in residential areas, while ensuring acceptable levels of amenity, and protection from the impact of traffic. (AMCORD 01, page 46).
- To avoid streets within any residential neighbourhood from operating as through traffic routes for externally generated traffic (AMCORD 010, page 46).

PERFORMANCE CRITERIA

- The design features of each type of street to convey its primary function and encourage appropriate driver behaviour (AMCORD P4, page 48).
- Street layout which provides that no allotment fronts a street which carries an unacceptable volume of traffic.
- Street layout which provides that a maximum percentage of allotments front streets which carry a minimum volume of traffic.

ACCEPTABLE SOLUTIONS

- Street layout which provides that no allotment fronts a street with a Traffic Catchment exceeding **450 dwelling units** (approx. 3000 v.p.d.) unless:-
  - The location and design of buildings is controlled to ensure acceptable traffic noise levels at the buildings.
  - Parking and access are specifically designed in accordance with Sections 10.5 and 10.9.
- Street layout which positively **excludes through traffic.**
- Traffic volumes to be calculated in accordance with criteria in Section 10.3, i.e. **6.5 trips/unit/day.**

EFFECT OF TRAFFIC SPEED

As detailed in Section 2.3, higher traffic speed in streets is detrimental to:-

- **Safety** of residents and street users, due to increased risk and severity of accidents;
- **Amenity** of residents, due to increased noise;
- **Convenience** of street users, due to greater gaps necessary to safely cross streets, or enter traffic from properties.

Lower traffic speed results in a reduction both in the number of accidents and in the severity of injuries, particularly where pedestrians or cyclists are involved.

CONTROL OF TRAFFIC SPEED

The means of providing a **consistently** lower traffic speed is by **restrictive geometric design** of the street based on an appropriate **"Design Maximum Speed"**.

DESIGN SPEEDS

The recommended **Design Maximum Speeds** for Multi-Unit Residential streets are the same as for the equivalent Residential streets, viz:-

- **Access Place and Access Street** - **30 km/h**
- **Collector Street** - **40 km/h**
- **Trunk Collector** - **60 km/h**

However, since by definition only identified **potential Bus Routes** are classed as **Collector Streets** in the Multi-Unit Street hierarchy, a greater proportion of streets will be Access Places and Access Streets, designed for **30 km/h** Design Maximum Speed.

This is considered appropriate in the Multi-Unit context as:-

- Pedestrian traffic is greater;
- Vehicle movements, entering and leaving properties, and parking and unparking are more numerous;
- Travel distances are typically less, due to the greater population density, and hence maximum travel time is not such a constraint.

VARIATION OF DESIGN SPEED

There are some situations where an increase in the Design Speed of an Access Street may be appropriate, e.g.

- **Travel Time**
  While travel time is not usually a constraint in Multi-Unit development, there may be the case of a long cul-de-sac with relatively low-density development, where total travel time rather than traffic volume is the critical design factor.

  Where the total travel time in the Access and Collector Streets would exceed **90 seconds** at 30 km/h Design Speed in the Access Streets, it would be appropriate to increase the Design Speed in the "lower" sections of the Access Streets to **40 km/h.**

- **Mixed Development**
  Where conventional Residential development is located "upstream" of Multi-Unit development there may be a Residential Collector Street, designed at 40 km/h, connecting into a Multi-Unit Access Street. In such a case it **may** be appropriate to design the Access Street for **40 km/h**, for consistency.

SPEED RESTRICTIVE DESIGN

Section 2.3 and Commentary 2.3 detail speed-restrictive methods and provide appropriate design criteria. However, the following points relevant to **Multi-Unit** streets are noted:-

- Carriageway widths, including necessary parking provision, are generally wider than for Residential streets. Design should seek to limit the **apparent width** as much as possible, to discourage higher speeds (see Section 10.6);
- The typically higher street parking demand creates "friction" for moving traffic, assisting speed control;
- The necessity to utilise angle parking in places, to provide required parking capacity, can create opportunities for more innovative speed restrictive alignments (Section 10.5 and 10.6).
- On streets identified as potential bus routes (generally all Collector and Trunk Collector Streets), speed control should be by **street alignment only**, rather than by speed control devices, which inevitably require vertical displacement of a bus (see Section 10.10).

TRAFFIC SPEED

OBJECTIVES

- To provide a street environment which allows all users - motorists, pedestrians and cyclists - to proceed safely and without unreasonable delay, (AMCORD 02, page 60), and which preserves residential amenity.

PERFORMANCE CRITERIA

- The design features of each type of street to convey its primary function and encourage appropriate driver behaviour. (AMCORD P4, page 62).
- Design of the carriageway to discourage motorists from travelling above the intended speed, by reflecting the function of the street in the network. In particular, the width and horizontal and vertical alignment not to be conducive to excessive speed. (AMCORD P5, page 62).
- Street design geometry which effectively restricts vehicular speeds to appropriate limits.
- Limitation of total travel time in the speed restrictive environment to acceptable limits.

ACCEPTABLE SOLUTIONS

- **Design Maximum Speeds** as follows:-

Access Street and Place	-	**30 km/h**
Collector Street	-	**40 km/h**
Trunk Collector Street	-	**60 km/h**

- **Speed Restrictive Design** to be applied in accordance with the criteria of Section 2.3.
- In **Collector Streets and Trunk Collector Streets,** speed restrictive design to be applied by street alignment only.
- **Total Travel Time** in the Access and Collector Street systems not exceeding **90 seconds.**

GENERAL

As discussed in Section 2.4, the **ideal** is for all residential parking to be provided **On-Site.** However, inevitably some provision is required for Off-Site, i.e. **On-Street** parking, to provide for:-

- **Some overspill of Residents' vehicles**
- **Visitors' vehicles**
- **Service and delivery vehicles**

The amount of On-Street parking which occurs will vary with a number of factors, including:

- **Amount of On-Site parking** provided which is generally dictated by the relevant Local Government Planning By-laws.

- **Availability of On-Street parking,** a plentiful capacity encouraging parking on the street rather than within development sites.

- **Allocation of On-Site parking** - Overspill of residents' vehicles will be less likely when at least some "communal" parking is provided (i.e. not allocated to specific units for exclusive use). This will enable balancing out of the overall parking demand by providing for variation in vehicle ownership between units.

- **Location of Residents' Parking** - Unless on-site parking spaces are in convenient proximity to the units, it may encourage parking on the street rather than in the spaces provided, particularly if the street frontage is "permeable".

- **Provision of Visitor Parking** on-site is required by most Planning Codes. However, unless policed by By-law Inspectors, there is a tendency for visitor parking spaces to be appropriated by residents, and for "Residents' Vehicles Only" signs to be erected at site entrances by Body Corporates.

- **Location of On-Site Visitor Parking** should be visible from the street, as visitors tend to be reluctant to enter a site unless unoccupied parking spaces are clearly visible.

- **Provision for Service and Delivery Vehicles** to stand and to manoeuvre readily within the site.

The Site Area can be expected to affect the On-Street Parking demand, other factors being equal, the larger the development the less the street parking demand per unit due to:-

- **Greater Ability to Balance Demand** variation within the on-site parking, both resident and visitor.

- **Greater Walking Distances** encouraging on-site rather than on-street parking.

- **Better Circulation and Manoeuvring** facilities for service vehicles can be provided.

ON SITE PARKING

While the amount of On-Site parking to be provided is the prerogative of the Local Government Planning By-Laws, any deficiency in the On-Site provision will inevitably result in an **increase in the demand for On-Street parking.**

A **generally appropriate** provision for On-Site parking is considered to be as shown in Table 10.5.A.

Size of Units (Bedrooms)	**1**	**2**	**3 or more**
Parking Spaces per Unit	1.25	1.50	1.75

RECOMMENDED ON-SITE PARKING
TABLE 10.5.A

Note: **Includes Visitor Parking,** at 0.25 spaces per unit.

These recommendations are based broadly on those of AMCORD Urban, but the following points from the Background Data for that publication are noted:

- Parking demand may vary significantly with the socio-economic status of the development and location, being perhaps 0.25 per unit less than above for lower status areas and 0.25 per unit more than above for higher status areas.

- Parking demand (i.e. car ownership) does **not** vary significantly with proximity to public transport (in contrast to trip generation).

The level of On-Site parking recommended above is not necessarily applicable for special accommodation such as **Pensioner Units or Retirement Developments**, where a considerably lesser provision may well be acceptable.

This provision appears reasonable in relation to the rate of **0.50 spaces per Dwelling** recommended for conventional Residential in Section 2.4, and is consistent with the results of a very limited survey carried out by Brisbane City Council in St Lucia (1985).

For Larger Developments some reduction in this basic rate is considered reasonable, for reasons as discussed above, and **quite arbitrarily** the following provision is suggested:

No. of Units	Car Spaces per Unit
1 - 12	0.25 (1:4)
20	0.24
30	0.22
40	0.20 (1:5)
50	0.18
60 and above	0.17 (1:6)

REDUCTION IN PARKING RATIO
TABLE 10.5.B

STANDARDS FOR STREET PARKING

There appears to be very little recorded data available on actual on-street parking demand generated by Multi-Unit development, and from factors identified above it could be expected that the demand could be **very variable.**

Hence locally recorded data should be applied wherever available.

However, from AMCORD Urban and Background Data thereto, it is considered that where On-Site Parking is provided generally in accordance with Table 10.5.A, a reasonable **basic On-Street Parking provision** could be:

- **0.25 Parking Spaces per Dwelling Unit** (1 space per 4 units)

SIGNIFICANCE OF ON-STREET PARKING

Compared to "conventional" Residential development, Multi-Unit development results in both a:-

- **Greater overall demand** for street parking, and

- **Greater variability** in demand.

For example, a "conventional" Residential lot of 17m frontage will have a design on-street parking demand of about 0.50 parking spaces (Section 2.4), representing about **17%** of the allotment frontage.

On the other hand, for Multi-Unit development,

- A development of 6 units on a 25m x 60m lot (1:250m^2) could have a street parking demand of 1.5 spaces, or about **36%** of the lot frontage (for parallel parking).

- A larger development, say 40 units on a 50m x 120m site (1:150m²) could require 8 spaces, (40 x 0.20), or **about 100%** of the site frontage for parallel parking.

Since driveways, speed control devices, landscaping "bulges", pedestrian crossing points and bus stops will take up a considerable proportion of the total street length, it is evident that "random" frontage parking cannot be relied upon to satisfy the On-Street parking demand, and **specific design** to provide the appropriate number of parking spaces is necessary.

PRELIMINARY ASSESSMENT OF FRONTAGE PARKING

As a guide for the preliminary assessment of On-Street parking requirements, the ratio of **Frontage Length per Dwelling Unit** is useful.

The available **Frontage per Unit** will vary considerably, dependent on the density of the development and the allotment dimensions, the general trend being for the **Frontage per Unit** to **decrease** as:

- **The Development Density increases**, and
- **The Number of Units increases** (since for an allotment of typical shape, the frontage to area ratio decreases with increasing area). However this trend is partially offset by the allowable reduction in parking provision for larger developments.

Table 10.5.C gives some indication of the **minimum Frontage per Unit** required for various parking configurations and ratios. These figures allow for the site driveway, and for some loss of parking length due to external street design features such as speed control devices, pedestrian crossing points, landscaped "bulges" etc., but the requirements for such features may vary considerably.

Parking Configuration	Parking Spaces per Unit 0.17	0.20	0.25
	(60units)	(40)	(12)*
Parallel	2.0m	2.5m	3.0m
Angle (90°)	0.8m	1.0m	1.2m

MINIMUM FRONTAGE (m) PER UNIT FOR VARIOUS PARKING PROVISIONS

TABLE 10.5.C

Note: * See Table 10.5.B

Examples:

(1) 6 Unit development @ 1:250m², frontage 25m
Frontage per Unit = 25/6 = 4.2m
Parking ratio 0.25 spaces per unit (Table 10.5.B)
From Table 10.5.C required parking can be provided as **parallel parking** (or optionally as angle parking)

(2) 40 unit development @ 1:150m², frontage 50m
Frontage per Unit = 50/40 = 1.25m
Parking ratio 0.20 spaces per unit (Table 10.5.B)
From Table 10.5.C required parking can be provided only as **90° angle parking.**

Generalised indications from Table 10.5.C are:-

- **Parallel** kerbside parking will provide capacity for most lower density developments (e.g. 1 unit:250m²), but only for **smaller developments** (e.g. 6-12 units), at higher densities (e.g. 1:150).

- **Angle Parking** (90°) can provide capacity for all developments.

DETAILED DESIGN CRITERIA

As discussed in Section 2.4, the options for On-Street parking are:-

- **On-Carriageway Parallel**
- **Indented Parallel Parking Bays**
- **Indented Angle Parking (normally 90°)**

The general parking requirements detailed in that Section also apply (e.g. dimensions to comply with A.S.2890.1 and Figure 2.4.G).

In the case of **Multi-Unit** residential development, the following particular requirements should be noted:-

- **On-Street Parking must be specifically designed**, to ensure that the appropriate total number of parking spaces is available.
- **Each Allotment** should have the appropriate number of spaces available within a **convenient walking distance** (say 75% of spaces within 25m of the nearest allotment boundary, all within 40m).
- **Marking Individual Parking Bays** is not always necessary (e.g. kerbside parallel parking) but the number available must always be specifically assessed.
- **Allotment Driveways** must be allowed for, whether constructed initially or with future development.
- **Parking on Dedicated Moving Lanes** should be discouraged, e.g. by a different carriageway surfacing, and/or by indenting the parking lane (see Section 10.6).
- **Additional On-Site Parking** may be necessary in some cases, e.g. higher density development with a restricted frontage.

Some typical parking options are shown in Figures 10.5.D to 10.5.F.

ANGLE PARKING

From Table 10.5.C it is evident that for higher densities and larger developments it may not be feasible to provide all the required on-street parking capacity in the form of parallel kerbside parking, thereby requiring the use of **angle parking** in some configuration.

While angle parking may not be appropriate for higher traffic volumes and speeds, for the relatively low volumes and design speeds applicable to both Access and Collector Streets, angle parking is an efficient and acceptable option, which lends itself to innovative design configurations. Nose-to-kerb angle parking causes less interference to through traffic during the parking manoeuvre than parallel parking, while the low traffic volumes and speeds provide reasonable opportunity for safe reversing from parking bays.

COLLECTOR STREETS

As speed control on **Collector Streets** should be by alignment only rather than by **Speed Control Devices** (Section 10.4), the loss of potential parallel parking length for such devices is avoided, but on the other hand **Bus Stops** may result in considerable loss of kerb length available for parking (typically 40m in about 300m street length).

HIGHER TRAFFIC VOLUME STREETS

Where a Multi-Unit development accesses to a street with a higher traffic volume, e.g. a **Trunk Collector Street,** where provision for on-street parking is inappropriate, special measures are necessary to ensure that **no parking demand is generated on the street.** These measures may include:-

- Provision of **Additional On-Site Parking,** say 0.25 spaces per unit above the recommendations of Table 10.5.A.
- **Visitor Parking Spaces** specifically marked, located conveniently, and either visible or signposted from the site entrance.

EXTERNAL PARKING GENERATORS

As well as parking capacity for frontage unit development, parking demand which may be generated by any other adjacent land uses such as shops, schools, and transport facilities must be recognised by the Local Government, and appropriately provided for.

Conversely, care must be taken in design to avoid any likely overspill of parking from Multi-Unit development into adjacent conventional Residential streets.

PARKING POLICY CONSIDERATIONS

From the foregoing it is evident that Local Government requirements for **On-Site parking** provision may require review if they provide for less than the recommendations of Table 10.5.A, to avoid a level of On-Street parking which may be incompatible with **Safety, Amenity and Convenience** criteria, and which may in any case be impractical to provide.

Additional specific On-Site provision would be appropriate for special cases such as:-

- **Higher development densities**
- **Sites with restricted frontage**
- **Sites with access to Trunk Collector Streets.**

PARKING

OBJECTIVES

- To provide sufficient and convenient parking for residents, visitors and service vehicles (AMCORD 01, page 34).
- To ensure that parked vehicles do not obstruct the passage of vehicles on the carriageway or create traffic hazards (AMCORD 02, page 34).

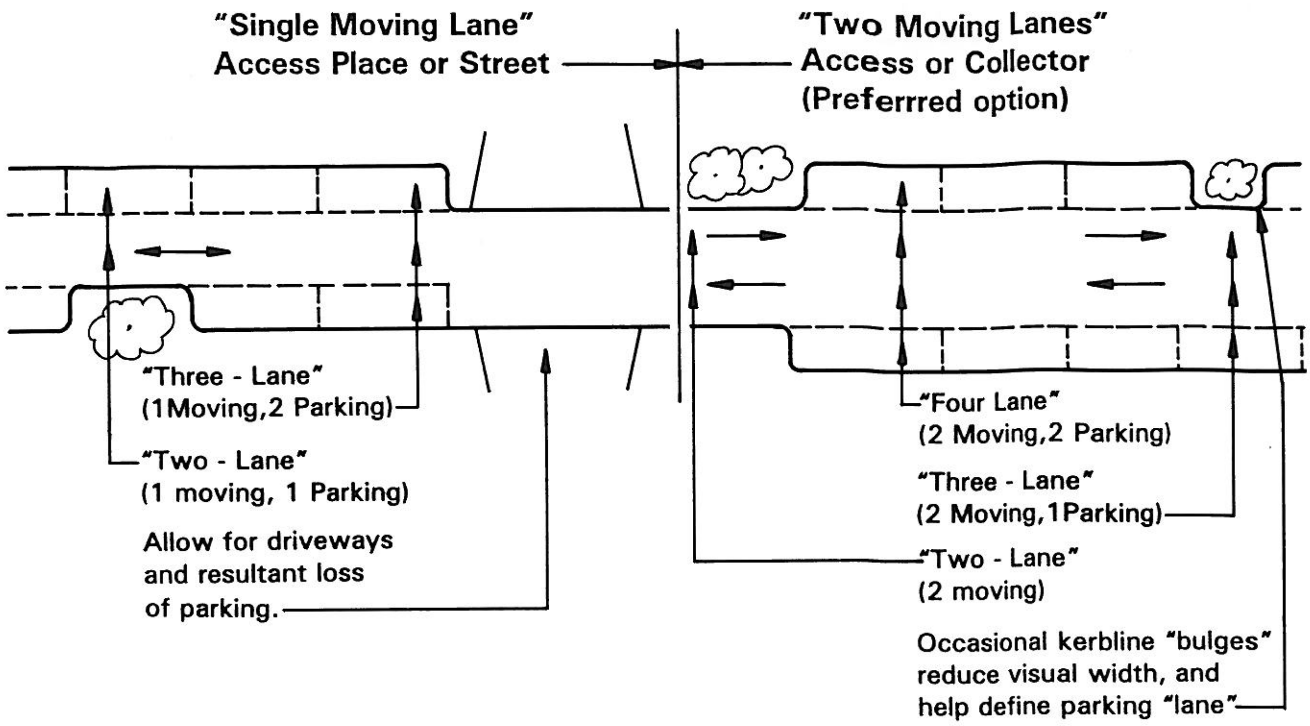
PERFORMANCE CRITERIA

- Provide resident and visitor carparking according to projected needs, taking into account:
  - Total parking demand;
  - Parking opportunities within allotments;
  - Non-residential and external parking generators.

  (AMCORD P1, page 34, modified)
- Parking provision designed to ensure:-
  - No obstruction or danger to the passage of vehicles on the carriageway, or to pedestrians;
  - Efficient design of parking spaces and accesses;
  - Convenient vehicle access to allotments.

ACCEPTABLE SOLUTIONS

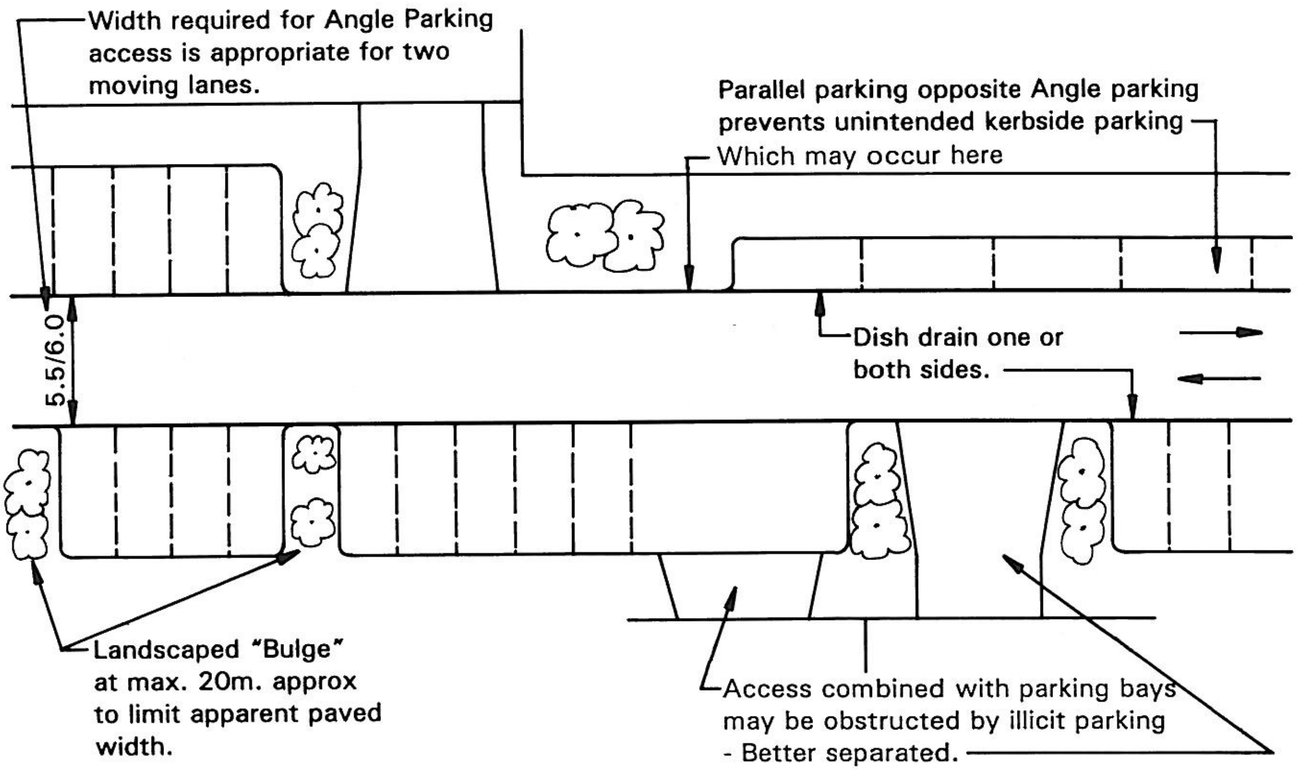
- Provision of **On-Site** parking within developments to a minimum level in accordance with Table 10.5.A.
- Provision of specifically designed **On-Street** parking to a minimum level in accordance with Table 10.5.B.
- On-Street parking appropriate for each allotment located such that 75% of spaces are within 25m, and 100% within 40m of the closest allotment boundary.
- Detailed design criteria for parking provision in accordance with Section 10.5.



Note: Individual Parking Bays are normally not marked. Parking "Lanes" may be distinguished from Moving Lanes by different paving or concrete dish, etc, particularly on Two - Lane and Three - Lane streets.

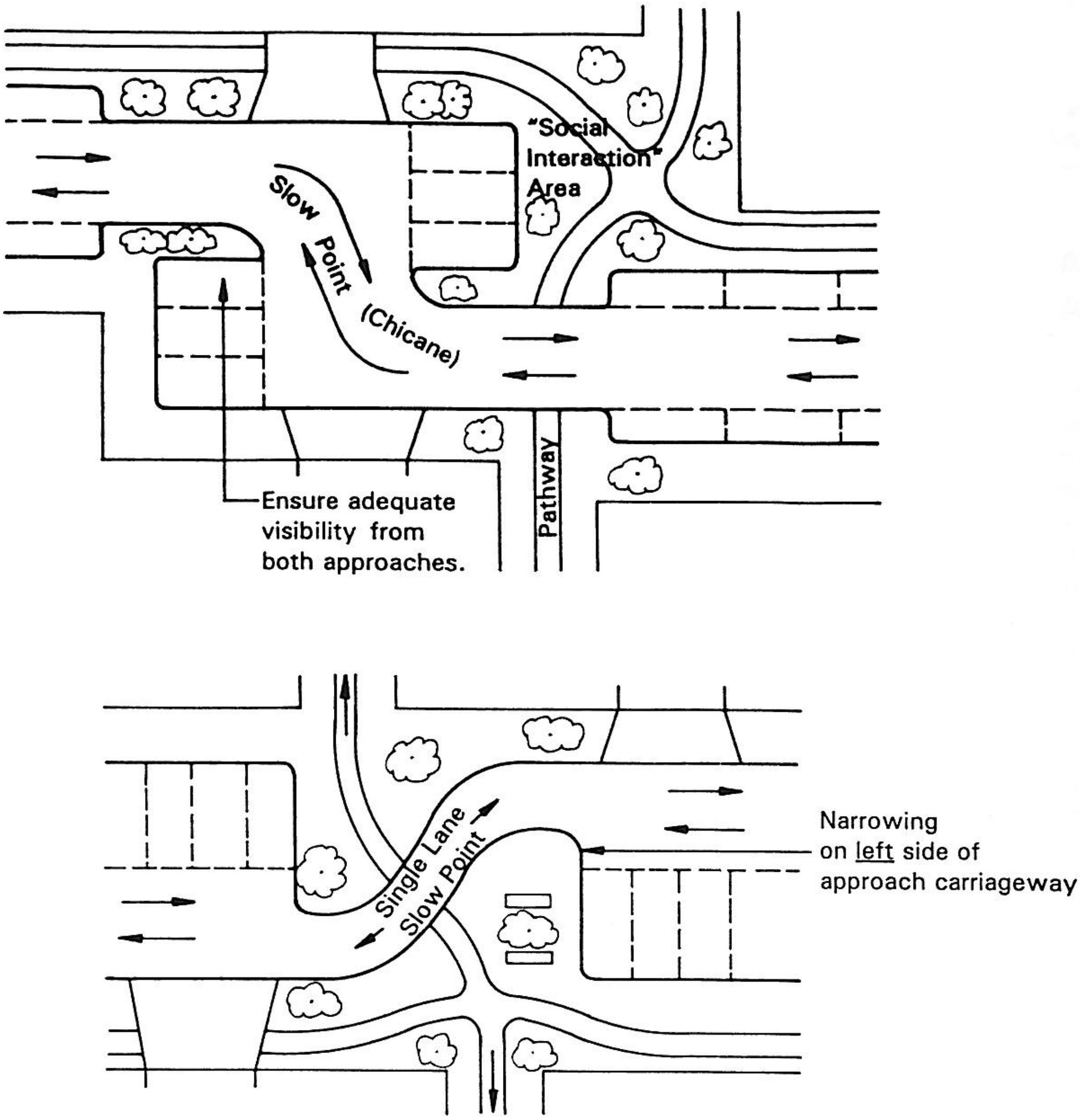
PARALLEL PARKING OPTIONS

FIGURE 10.5.D

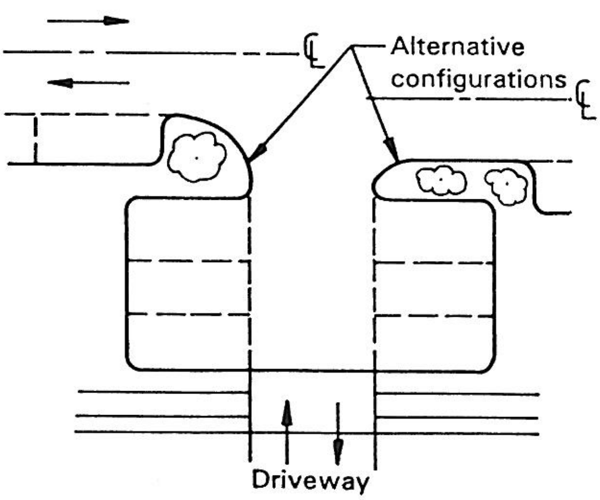


ANGLE PARKING OPTIONS

FIGURE 10.5.E



A. COMBINED WITH SLOW POINTS ON ACCESS STREETS



Angle parking bays separate from through lanes. Combining with a driveway reduces total paved area, and number of access points.

B. ALTERNATIVES FOR COLLECTOR STREET

ANGLE PARKING FURTHER OPTIONS

FIGURE 10.5.F

RANDOM PASSING OPPORTUNITY

As described in Sections 2.5 and 2.6, the design of conventional Residential streets relies on the principle of "**Random Passing Opportunity**", which assumes that the demand for kerbside parking is sufficiently low that there will be always be gaps in the kerbside lanes to provide the opportunity to pass opposing vehicles, albeit occasionally with minor delays.

However, from Section 10.5 it is apparent that the On-Street parking demand in **Multi-Unit streets** is much greater, and also much more variable, the "kerbside parking demand" ranging from about 36% to 100% of site frontage, compared to typically about 17% for conventional Residential lots.

Hence the occurrence of sufficient gaps in the kerbside lanes to provide the necessary passing opportunity can no longer be relied upon.

For a "**Two-lane**" street (5.5m carriageway) such as recommended for a Residential Access Street, even the lower incidence of parking demand (about 36% of frontage) occurring at random on either side, would probably block the street even for a single moving vehicle, let alone providing opportunity for passing an opposing vehicle.

In the case of a "**Three Lane**" Street (7.5m carriageway), such as recommended for a Residential Collector Street, the centre lane would always be available for a moving vehicle, but random gaps in the kerbside parking for passing could only be relied on for the lower range of parking demand, say up to 50% of frontage. Given the potential for much greater parking demand, this configuration also is not considered a practical option for Multi-Unit streets.

DESIGNED PASSING

Since "Random Passing Opportunity" cannot be relied upon, the conclusion is that Passing Opportunity must be **designed** into the street configuration, as either:

- **Two Moving Lanes,**
  or
- **Single Moving Lane** with designed passing.

TWO MOVING LANES

This configuration provides **two dedicated moving lanes,** and hence unrestricted passing opportunity, with required parking capacity provided as additional parallel-parking lanes on one or both sides, and/or angle parking bays.

Effectively, the total width will be 3 or 4 lanes over much of the length. However the design should **minimise the apparent width,** by providing narrowing to two lanes (perhaps even 1 lane) at Slow Points, and by intermediate kerb-line "bulges".

Where there is no kerbside parking lane, the dedicated **moving lanes require to be distinguished** by different surfacing, or by indenting the parking areas, to avoid unintended parking.

This configuration has a **traffic capacity suitable for all relevant volumes** for frontage access streets, i.e. 3000 v.p.d., or such higher volume as may be acceptable by special sound attenuation measures (see Section 10.4).

A simplified version (the "Lazy Designer's Option") could be a continuous "Four Lane" carriageway, with two dedicated moving lanes, and a continuous parallel parking lane each side. While suitable for **all relevant traffic volumes**, the limitation is parking capacity, which is a maximum of **about 70% of frontage each side**, allowing for driveways, but **not** for slow points etc. Adequacy of parking availability should be checked in all cases.

The constant considerable width of this configuration is potentially detrimental to Safety and Amenity, and at the least, narrowing to two lanes should be provided at Slow Points and Pedestrian Crossing Points.

SINGLE MOVING LANE

The Single Lane with designed parking and passing is described in the Residential context in Sections 2.5 and 2.6, but as noted in Commentary 2.5 has proved to be an unpopular option.

In the Multi-Unit context, provision of the required parking capacity as parallel parking on one or both sides, and/or angle parking bays, will result in **effectively two or three lanes** over most of the street length, avoiding the appearance of a "single lane only" street, and when parking demand is low providing for random passing, as well as at designed passing locations.

Where there is no kerbside parking lane (i.e. less than three lanes width) the moving lane needs to be **distinguished from the parking lane(s)**, by indented kerb configuration, and/or different paving material.

Passing bays may be provided in association with **90° parking** (Figure 2.5.A), or at a dual-purpose **Speed Control Device**, such as a Central Median.

The **limit** for application of the Single Lane concept is the **delay** which results from giving way to opposing traffic. As opposing traffic increases, the spacing of Passing Places should be reduced, the practical limit occurring at a spacing (i.e. length of constriction) of about 35m, at which spacing the appropriate maximum traffic catchment is about **120 units** (about 80 v.p.h.).

Table 10.6.A provides appropriate maximum Passing Bay spacings for various Traffic Catchments, based on criteria similar to those in Section 2.5.

Units in Traffic Catchment (No.)	Maximum Spacing of Passing Bays (m)
80 or less	80
90	65
100	50
110	40
120	35

PASSING BAY SPACING FOR SINGLE LANE CARRIAGEWAY TABLE 10.6.A

Notes: - "Spacing" is the length of single-lane carriageway between passing places.
- 80m is the practical maximum spacing for intervisibility.

The catchment limit will restrict the use of this configuration to a **short cul-de-sac** (Access Place) with smaller, lower-density sites, or to the **centre section of a "loop" street** (Access Street), the length being dependent on site densities and sizes.

A further limitation to its use is the possible delay to **emergency vehicle access,** which is potentially more significant than in conventional Residential streets.

Hence, though this configuration is theoretically valid, it is **not recommended as an "Acceptable Solutions" option,** but may be considered for limited use in appropriate situations.

CARRIAGEWAY WIDTHS

Typically, carriageway widths will be a varying combination of two, three or four parallel moving/parking "lanes", with occasional angle parking bays.

Recommended Carriageway Widths are shown in Figure 10.6.B.

Widths for Access Places and Streets conform generally with the recommendations of Figure 2.6.F for Residential Streets, while also providing for consistent channel invert lines.

However, on a **Collector Street,** being an identified potential **Bus Route**, widening of the two moving lanes to 6.0m (total) and the parking lanes to 2.5m each is considered appropriate.

RECOMMENDED OPTIONS

From the above discussion, the **recommended options** for the Carriageway configuration are:-

- **Access Place, Access Street and Collector Street**

  - **Two Moving Lanes** with designed parking, (either parallel or angle)

  - Maximum Traffic Catchment 450 units

  Except that a Single Moving Lane may be considered for limited use on an Access Place or Street, only where appropriate.

- **Trunk Collector Street**

  - Criteria in accordance with Section 2.14 and Figure 3.7.C.

DESIGN OPPORTUNITIES

The variations in carriageway configuration inherent in satisfying the various requirements of carriageway width, parking capacity, passing opportunity, and speed-restrictive devices provide opportunity for innovative design, particularly where Angle Parking is provided.

Given the much greater development yield per length of street, there should also be the economic capacity to provide for rather more sophisticated design than might be reasonable for conventional residential streets.

TYPICAL CONFIGURATIONS

Some typical designs for various street classifications and development densities are shown in Figures 10.6.C to 10.6.F.

CARRIAGEWAY

OBJECTIVES

- Carriageway width to be sufficient to enable the street to perform its required traffic and parking functions efficiently, safely and conveniently, but in the interests of economy to be no greater than necessary for these purposes.

- Carriageway construction standard to minimise both capital cost and future maintenance costs.

PERFORMANCE CRITERIA

- Carriageway width sufficient to provide for two dedicated moving lanes, plus required parking capacity as parallel kerbside lanes, or indented parallel or angle parking bays.

- Alternatively, where appropriate, design for a single dedicated moving lane plus designed passing opportunity, and designed parking capacity as above.

- Carriageway width to be the minimum necessary for normal traffic movements to be carried out at the design speed, with abnormal movements possible at reduced speed.

ACCEPTABLE SOLUTIONS

- Carriageway **Moving Lane** widths to be:-

Single lane	-	**3.5m**
Two lanes	-	**5.5m**
Two lanes (bus route)	-	**6.0m**

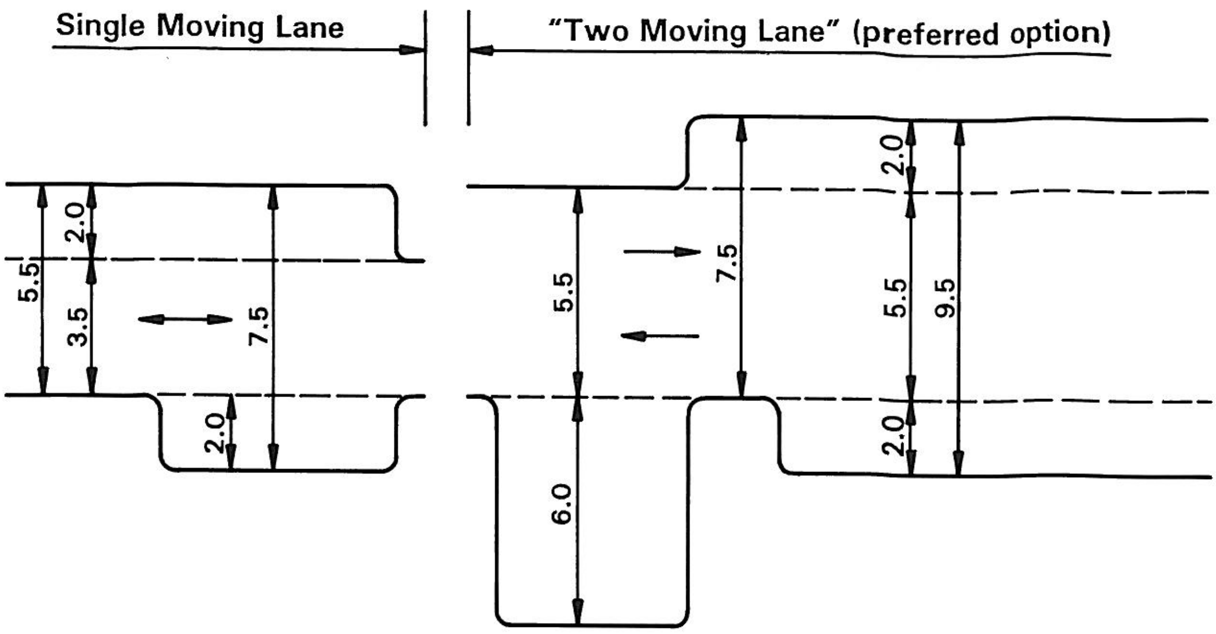
- **Standard Moving Lane** provision to be:

Access Place and Street	-	**5.5m width**
	-	**Max. traffic catchment 450 units**
Collector Street	-	**6.0m width**
	-	**Max. traffic catchment 450 units**

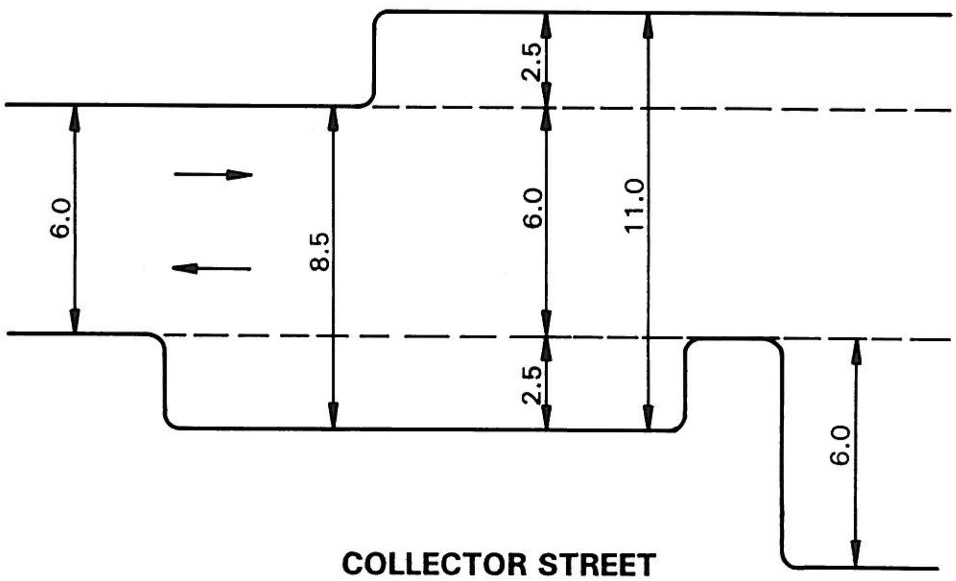
- Carriageway **Parking Lane widths** (parallel parking) to be:-

Other than Bus Route	-	**2.0m**
Bus Route	-	**2.5m**

- **Angle Parking bays** to be in accordance with Figures 10.6.B and 2.4.G and Section 10.5.



ACCESS PLACE AND ACCESS STREET

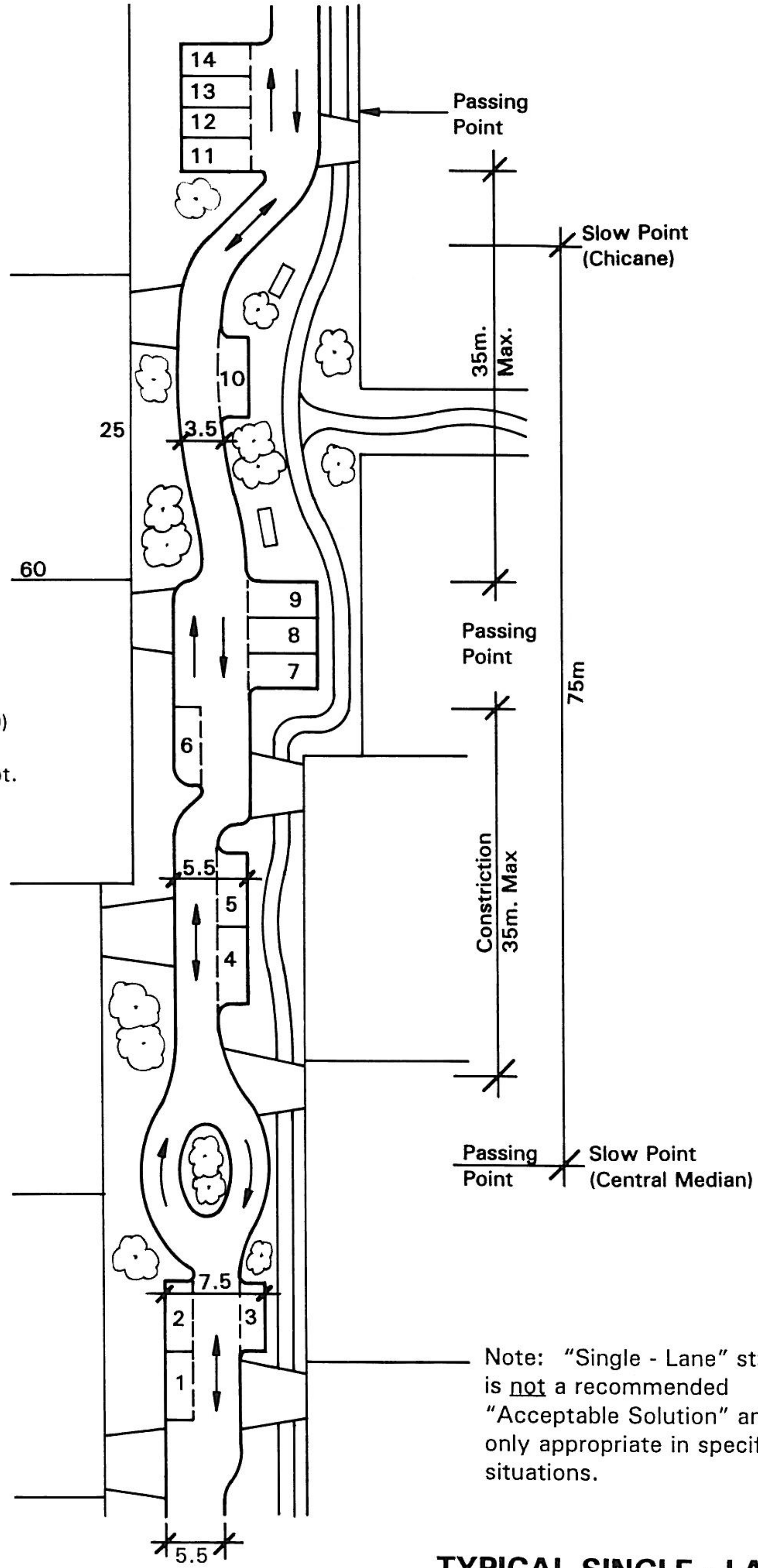


COLLECTOR STREET

Note: Dimensions to
channel invert

RECOMMENDED CARRIAGEWAY WIDTHS

FIGURE 10.6.B

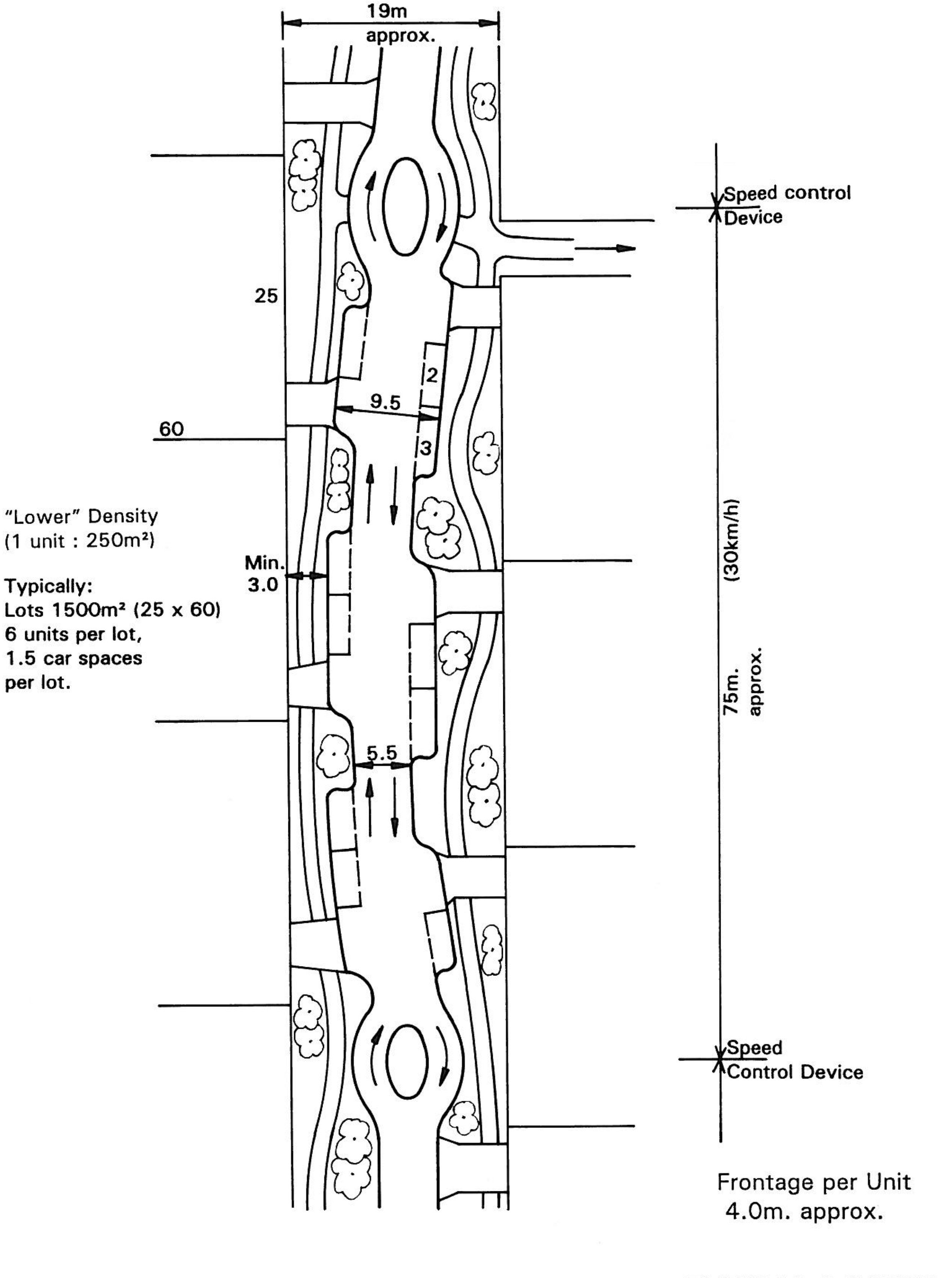


"Lower" Density
(1unit : 250m²)
Typically:
Lots 1500m².(25x60)
6 units per lot,
1.5 car spaces,per lot.

Note: "Single - Lane" street is not a recommended "Acceptable Solution" and is only appropriate in specific situations.

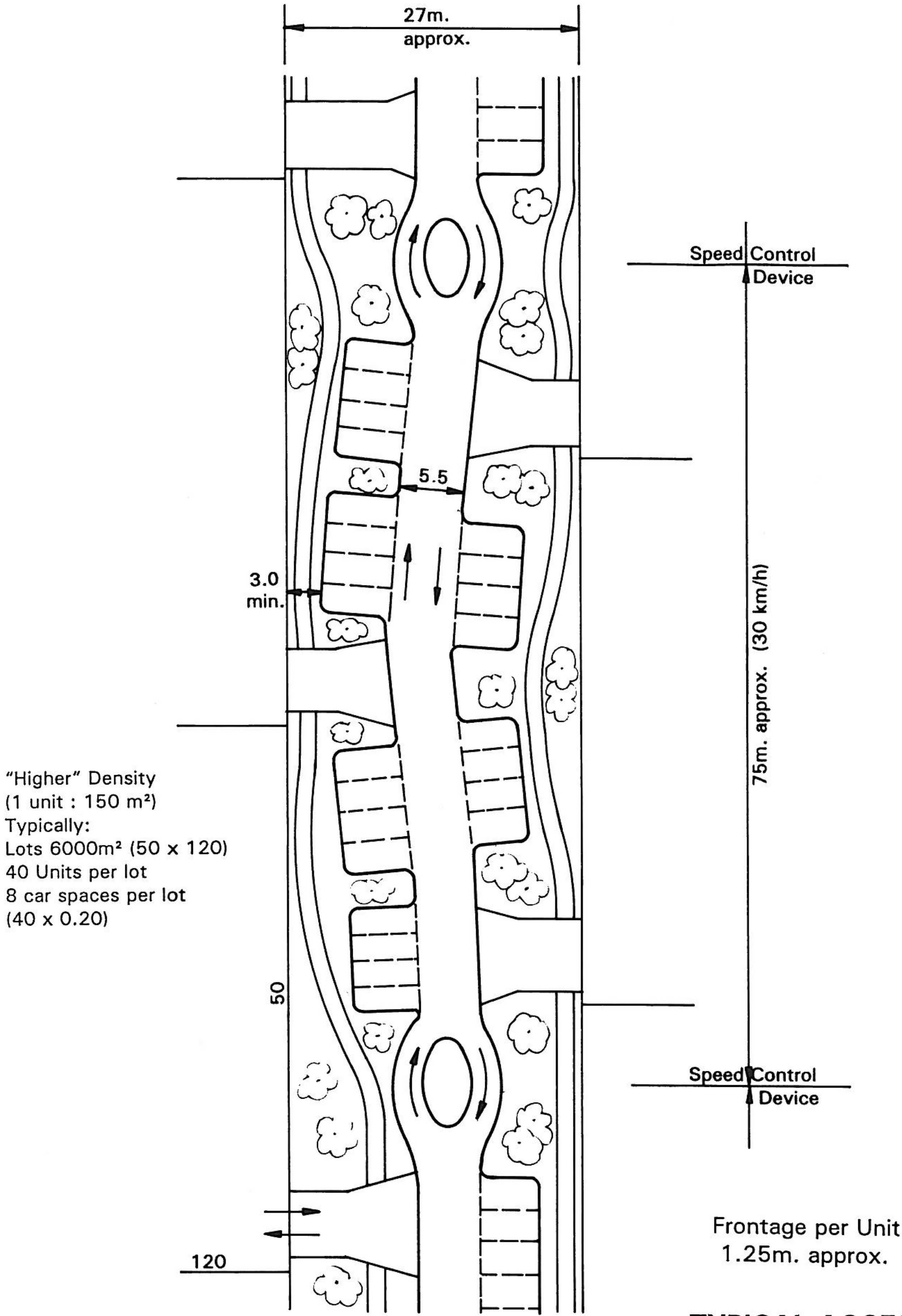
TYPICAL SINGLE - LANE ACCESS PLACE OR STREET

FIGURE 10.6.C



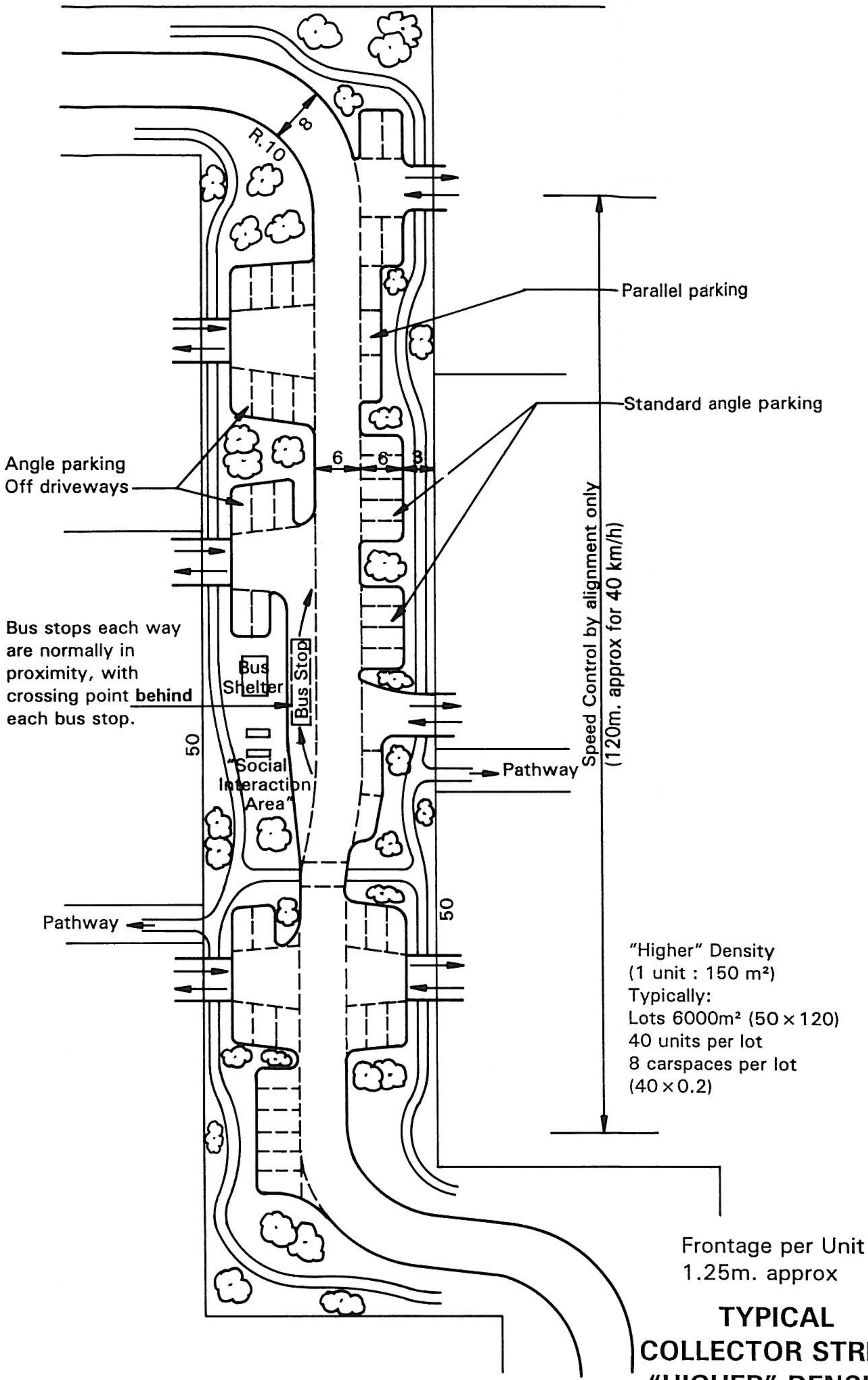
TYPICAL ACCESS PLACE OR STREET "LOWER" DENSITY

FIGURE 10.6.D



TYPICAL ACCESS PLACE OR STREET "HIGHER" DENSITY

FIGURE 10.6.E



TYPICAL COLLECTOR STREET "HIGHER" DENSITY

FIGURE 10.6.F

FUNCTIONS OF THE VERGE

The verge on Multi-Unit Residential streets fulfils the same functions as for Residential streets (see Section 2.8), although the significance and requirements for these functions may differ.

- **SAFETY VISIBILITY**

  Provision of a parking lane over probably most of the street length provides an additional "buffer width" between pedestrians and moving traffic, and for vehicles exiting from properties.

  Further, as the internal development layouts should be such that all vehicles can exit from properties in the forward direction, the verge width is less critical for exiting vehicles.

- **PARKING**

  Provision of formal parking spaces should make it less likely, and more difficult, for informal parking on the verge to take place.

  However, **"overspill" parking** on the verge, in addition to constructed parking areas, **may still occur** occasionally.

- **LANDSCAPING**

  Space for landscaping is **even more important** than in conventional Residential streets, to help provide visual amenity to offset the potential negative factors of increased impervious carriageway and parking areas, and greater building bulk and site coverage.

- **UTILITY SERVICES**

  The higher development density will typically require utility services of **greater capacity** than in conventional Residential streets, with consequent **less flexibility** in location and alignment.

  The greater width of street reserve necessary to accommodate parking requirements, and the relatively greater size of the individual service connections, may result in it being more economic to provide utility services (e.g. watermains) on each side of the reserve, rather than on one side only with cross-street service connections.

- **CHANGES IN LEVEL**

  Multi-Unit development is generally **not** appropriately located on steeply sloping land, and hence verge crossfall should **not** normally be a problem.

  However, on moderate side-slopes the combined total width of carriageway and parking, particularly where angle parking is necessary, may result in potential vehicular access problems. In such cases, **normal Residential street criteria apply.**

- **PATHWAYS**

  The greater population density, and generally lesser distances to services, will result in **considerably greater pedestrian traffic** volumes in Multi-Unit streets. With the much greater incidence of on-street parking, pedestrian movement on the carriageway, even in streets with lower vehicular traffic volumes, is generally **not** appropriate.

  Hence provision should be made for a constructed pedestrian footpath within the verge on **both sides of every street.** However footpath construction on one side only of an Access Place or Access Street may be acceptable where the traffic catchment is less than perhaps **50 units.**

  Usually, cyclists may utilise the carriageway of all Multi-Unit Access and Collector Streets. However, on Trunk Collector Streets or identified Cycle Routes, a Dual Use Path within the verge may be required.

- **BUFFER AREA**

  The provision for on-street parking increases the distance between moving vehicles and the street reserve boundaries, compared to conventional Residential streets, thereby providing increased sound attenuation distance.

  Hence standard verge widths and minimum building setbacks will normally provide **adequate noise buffering,** except where access is to streets with higher traffic volume and speed (see Section 10.3).

VERGE WIDTH

The **Verge Width,** in the context of Multi-Unit streets, is the distance from the reserve boundary to the channel, or nominal kerb line, of the nearest adjacent moving lane or constructed parking lane or bay.

MINIMUM VERGE WIDTH

Based on the above discussion, and on the criteria established in Section 2.8, the following **Minimum Verge Widths at any point** are considered to be appropriate:-

- **General Minimum, all Streets 3.0m**

  - Except that the width should be **3.5m minimum** where there is no parking lane or parking bay between the "moving" lane and the reserve boundary.

  - Except that where a footpath is not required, the width to a short indented **Angle Parking bay** may be **1.5m minimum,** provided that acceptable provision is made for utility services (e.g. clear of parking bay, or in conduit under the bay).

AVERAGE VERGE WIDTH

While the **Minimum Verge Widths** quoted above are adequate to provide for the technical functions of the verge, they are insufficient to provide reasonable **landscaping opportunity,** particularly as the general requirement for a constructed footpath on both sides leaves very little space available for planting.

In general, the combined width of the carriageway and parking lanes/bays will vary over the street length. This gives the opportunity to **vary the verge width** also, and to provide occasional wider sections of verge for consolidated areas of landscaping, or even for development as "social-interaction places" (mini-parks), with seating and shade trees. On Collector Streets such areas can appropriately be located adjacent to bus stops (see Figure 10.6.F).

Hence the **Average** verge width over the street length should be greater than the "Minimum Width at any point".

Indicative **Average Verge Widths,** to provide reasonable landscaping opportunity, are:

- **Access Place or Street - 4.5m**
- **Collector Street - 5.0m**

VERGE

OBJECTIVES

- To provide a buffer area between the street carriageway and parking bays, and the Multi-Unit allotments, sufficient for the functions of Safety, Amenity and Convenience.
- In the interest of Economy, the verge widths to be no greater than reasonably necessary.

PERFORMANCE CRITERIA

Verge Width adequate for the requirements of:-

- Pedestrian movement
- Noise reduction
- Landscaping for amenity
- Utility services
- Changes in level

ACCEPTABLE SOLUTIONS

- **General Minimum Verge Width at any point:**
  All Streets - 3.0m
- **Additional width** as required to satisfy Performance Criteria.
- **Average Verge Width:**
  Access Place or Street - 4.5m
  Collector Street - 5.0m
- **Verge Cross-Section** generally in accordance with Figure 2.8.F.
- **Pedestrian footpaths** constructed on both sides of every Street.

STREET RESERVE 10.8

The **Minimum** Street Reserve Width at any point will be the sum of the necessary carriageway and parking provisions, plus the applicable minimum verge width from Section 10.7, while the **Average** Reserve Width over a street length will be the sum of the average carriageway and parking provision, and the average verge width.

As the width required for **Parking**, in particular, may vary considerably, both the Minimum and Average Reserve Widths are subject to much greater potential variation than for conventional Residential streets, and these widths can only be determined by detailed design.

However, as a guide for preliminary planning, the following widths are indicative of likely **Average Reserve Width** requirements:-

	Lower Parking Demand (Parallel Parking)	**Higher Parking Demand** (Angle Parking)
Access Place or Street	**19m**	**27m**
Collector Street	**21m**	**28m***

AVERAGE RESERVE WIDTHS
TABLE 10.8.A

Note: * Detailed design may require greater local Reserve Width.

STREET RESERVE

OBJECTIVES

- To provide an appropriate street reserve width to accommodate the identified carriageway and parking requirements, and to provide for verges either side of sufficient width to satisfactorily fulfil the required verge functions.
- In the interests of economy, street reserve width to be no greater than reasonably necessary.

PERFORMANCE CRITERIA

- **Minimum street reserve width** at any point to be not less than the sum of the minimum widths required for the Carriageway, Parking and the Verge, as identified in Sections 10.5, 10.6 and 10.7.
- **Average street reserve width** to be sufficient to provide some variation in the carriageway location within the verge, and to provide opportunity for adequate landscaping.

ACCEPTABLE SOLUTIONS

- Reserve widths in accordance with Table 10.8.A.
- Additional width as required to satisfy Performance Criteria.

GENERAL

Vehicular access from streets to Multi-Unit developments should be located and designed generally in accordance with the provisions of AS.2890.1-1986 "Off-Street Parking Part 1 - Car Parking Facilities", and any relevant standards of the Local Government.

In applying AS.2890.1, relevant criteria will generally be:-

- **Turnover Rate** - **Low to Medium**
- **Frontage Road** - **Minor (Access & Collector)**
  - **Major (Trunk Collector)**

MAXIMISING KERB LENGTH

In Multi-Unit streets kerb length is at a premium, both to maximise on-street parking capacity, and to provide for speed control devices, etc.

Hence the kerb length taken up by property accesses should be kept to the reasonable minimum, by:

- **Limit of one access per allotment**, except perhaps for very large developments;
- **Access Widths to be no greater than necessary** for reasonable operation.

DESIGN VEHICLE

The standard Design Vehicle for design of accesses should be the **B99 Car**, with a turning path radius of **7.5m**. The vehicle paths should be based on turning to and from the moving lane nearest to the property boundary.

For all but the smallest developments, **garbage collection** will usually be **internal**, the garbage truck entering the site and collecting either from individual bins or a common industrial bin. The alternative of a multitude of individual wheelie bins on the street would be both aesthetically unacceptable and impractical due to parked vehicles. However, the division point between external and internal pick-up varies with the Local Government policy. Where a garbage truck will typically enter the development, the access must be designed for the appropriate vehicle, but if necessary turning from the far moving lane.

INTERNAL SITE LAYOUT

All developments with three (3) or more units should have an internal layout which permits a vehicle to **turn on site** and hence both enter and leave the site in the forward direction.

All such developments should also have adequate provision for **queuing within the site** for entering vehicles.

ACCESS DETAILS

Although most Councils have standard crossing designs, the following criteria are recommended.

CROSSING TYPE

- All crossings to **Access and Collector** Streets should be **Splay Type** concrete crossings;
- Crossings to **Trunk Collector Streets** should generally be **Kerb Return** type entrances, designed as for an intersection, as only large developments with accesses at infrequent intervals should normally be permitted to access from Trunk Collectors.

CROSSING WIDTH

- Developments with **less than ten (10) parking spaces** on site may generally have a **Single Lane** crossing, 3.0m or 3.5m at the property boundary, and 5.0m or 5.5m at the kerb. (Note loss of parallel parking is 7.0m.)

- Developments with **ten (10) to three hundred (300)** on site parking spaces should generally have a **Two Lane Undivided** crossing, 6.0m wide at the property boundary, and 8.0m wide at the kerb (loss of parallel parking 10.0m).

- Developments with **over three hundred (300)** on site parking spaces should have a **divided** crossing (AS.2890.1 Category 3 or 4).

- Except that major developments with access to a **Trunk Collector** require specific design, generally based on intersection criteria.

ACCESS

OBJECTIVES

- Provision of safe and convenient vehicular access from the street to all Multi-Unit Residential allotments.

PERFORMANCE CRITERIA

- Accesses designed for an appropriate Design Vehicle.

- Location and design of accesses for safe operation of traffic, and for pedestrian safety.

- Number and design of accesses to minimise loss of kerb length for parking and traffic functions.

ACCEPTABLE SOLUTIONS

- **One access only** per allotment

- **Internal site layout** providing for turning of vehicles and adequate vehicle queuing within the site.

- **Location and design** of crossings in accordance with AS.2890.1-1986, and the provisions of Section 10.9.

GENERAL

Design requirements for other aspects of Multi-Unit streets are generally in accordance with the relevant provisions for **Residential Streets**, unless otherwise noted, viz:-

GEOMETRIC DESIGN

In accordance with the provisions of **Section 2.10 and Commentary**, using the **Design Maximum Speeds** as recommended in Section 10.4.

INTERSECTIONS

In accordance with **Section 2.11 and Commentary.**

TURNING AREAS

In accordance with **Section 2.12 and Commentary.**

SPEED CONTROL DEVICES

In accordance with **Section 2.13 and Commentary.**

STORMWATER DRAINAGE

Provision should be generally in accordance with QUDM (Queensland Urban Drainage Manual), viz:-

•Minor System

- A.R.I.	10 years
- Flow Widths and Depths	As per Tables 5.01.1 and 5.09.1 for "Minor Road" (QUDM)

•Major System

- A.R.I.	100 years
- Flow Depths	As per Table 5.01.1 (QUDM)

However the relevant flow depths from QUDM should be adjusted for the kerb profile in use, to maintain the same maximum depth of flow at the **channel lip**, and the same **verge freeboard**, as recommended by QUDM.

Pedestrian Traffic Volumes are such that the recommended limits of flow width and depth adjacent to crossing points and bus-stops should be complied with.

Indented Parking Bays, with the consequent irregular kerb line, may complicate drainage design, particularly on flat grades. A continuous channel/dish crossing on both sides of two moving lanes, or on one side of a single dedicated moving lane, with the parking bays falling to the dish drain(s), may be the most appropriate design treatment.

STREET SYSTEM

While the criteria of Section 3.0 apply generally to Multi-Unit streets, as well as to conventional Residential streets, the following aspects should be emphasised:-

- **Possible Future Street Connections** should be considered where development adjoins a "Core Area", and where mixed use development may later expand from the Core Area into the Multi-Unit area. In such cases, dedication without construction of potential future street links may be appropriate, the reserves serving in the interim as Open Space areas and pedestrian/cycle path links (see Commentary 1.8 and Commentary 3.0).

- **Alternative Street Access** is of greater importance, due to the greater development density, and hence relatively greater traffic volumes, and greater potential for emergency vehicle access requirements. Particularly for high-density development (eg Frontage per Unit 2m or less), a **looped** street system is preferable to cul-de-sacs.

- **Potential Bus Routes** should be provided for, as considered in detail below.

PEDESTRIANS AND CYCLISTS

- **Pedestrian Connectivity** of a high order is even more important in Multi-Unit areas, due to the greater population density, and potentially reduced distances between residences and facilities.

- **Within the Development** pedestrians are provided for by constructed footpaths generally on both sides of each street (see Section 10.7), while cyclists can appropriately use the carriageway on all Access and Collector Streets.

- **Connecting Pathways** for both pedestrians and cyclists should be provided to minimise travel distances to all facilities (see Section 4.0 and Commentary).

BUS ROUTES

As previously noted, the much greater population density in Multi-Unit areas means that the provision of an "ideal" bus service is **more economically feasible** than in areas of conventional Residential development density, and hence more likely to eventuate in practice.

It is therefore even more important in Multi-Unit development to identify the potential bus routes, and also the likely bus stops, and to design the streets accordingly.

Bus Route criteria are:-

- Routes should efficiently connect with existing or likely future transport nodes, and link to major activity centres within and external to the development.

- **90% of dwelling units** should be within **400m of a bus route** (or 500m of a bus stop where identified).

- Routes should desirably be **not more than 30% longer** than the equivalent shortest route.

- Routes will be located on **Trunk Collector Streets** or **Collector Streets** (by definition).

- Such streets should have restrictive speed design effected by **street alignment,** and not by Speed Control Devices which inevitably involve vertical displacement of a bus.

- Carriageway and parking bay **widths should be increased** appropriately (see Section 10.6).

- **Maximum street gradient** should desirably be **6.0%.**

Bus Stops should be specifically located, as their design may require additional reserve width for indented bays, and seats or shelters, and as they will significantly reduce the kerb length available for parking.

Criteria are:-

- Stops should be provided at all **traffic generators**, such as shopping centres, community centres, schools and transit interchanges.

- Stops should be located at approximately **300m spacing.**

- Location should relate to the **pedestrian pathway** network, to facilitate passenger access.

- Street design should **assist pedestrian safety**, e.g. by a median with refuge, preventing overtaking a stationary bus; or indented bus bays, offset with a crossing point between.

- Adequate verge width for a waiting **seat or shelter** should be provided.

SUMMARY

A summary of "**Acceptable Solutions**" criteria, as identified in the previous sections of the Guidelines, is provided in Table 10.11.A.

DESIGN EXAMPLES

Some typical configurations for various Street Classifications and Development Densities are shown in Figures 10.6.C to 10.6.F.

MULTI-UNIT RESIDENTIAL STREETS
SUMMARY OF "ACCEPTABLE SOLUTIONS" CRITERIA

	Access Place (i) and Access Street	Collector Street (ii)
Traffic Catchment (max.)	450 units	450 units (iii)
Design Speed	30 km/h (iv)	40 km/h
Carriageway		
- Moving Lanes (2 no.)	5.5m (v)	6.0m
- Parking Lanes (each)	2.0m	2.5m
Verge Width - Minimum	3.0m (vi)	3.0m (vi)
- Average	4.5m	5.0m
Reserve Width		
- Parallel Parking	19m (vii)	21m (vii)
- Angle Parking	27m (vii)	28m (vii)
Footpaths	Both sides (viii)	Both sides
Parking	Carriageway - Parallel or angle	Carriageway - Parallel or angle

TABLE 10.11.A

Notes:

(i) Difference is in subdivision layout only not in street design.
(ii) By definition, a potential Bus Route.
(iii) May be exceeded with special design.
(iv) 40 km/h in special circumstances (See Section 10.4).
(v) Single moving lane 3.5m, in special circumstances (see Section 10.6).
(vi) 3.5m if no parking adjacent (see Section 10.7).
(vii) Indicative only, actual width required varies with parking configuration (see Section 10.5).
(viii) Possibly one side only, where traffic catchment less than 50 units.

Other Criteria (e.g. Crossfall, Sight Distance) as for Residential Streets (Section 2.14).

Trunk Collector criteria as set out in Section 2.14 and Figure 3.7.C.

UPGRADING OF MAY 1993 EDITION

QUEENSLAND STREETS

"QUEENSLAND STREETS"

UPDATING MAY 1993 EDITION

The updating kit for your current edition of "**Queensland Streets**" consists of the following components:-

- **New Commentary Pages**
  To be inserted at the end of each relevant Section. These pages are generally **additional** material, but in some cases replace existing pages.

- **"Flagging"** of relevant paragraphs in the existing text, to indicate that there is additional reference material in the new Commentary Pages.

  For a neat appearance a sheet of stick-on dots is supplied to act as "flags", but marking may be by hand if preferred.

- **Amendments** to the existing text, in a few cases where there are typographical errors or where amendment is simpler than reference to the Commentary Pages.

  These Amendments are intended to be done by hand.

A sequential list of all the updating operations required is attached.

QUEENSLAND STREETS
Updating of May 1993 Edition

Page Nº	Amendment
1	Substitute new "Contents" pages
6	Flag sub-par "Application"
10	Insert new pages 10.A to 10.D
18	Flag "Figure 2.2.D"
18	Insert new page 18.A
21	Flag "Speed Restrictive Design"
21	Flag "Street Length"
21	Flag "Bends or Curves"
22	Flag "Note" on Table 2.3.C, and "Length of Straight" on Table 2.3.D
22	Insert new pages 22.A and 22.B
23	Flag "Street Leg Length" on Figure 2.3.B
24	Flag "Parking Within Allotments"
26	Flag "Parallel Parking Requirement"
28	Insert new page 28.A
31	Flag "Single Lane Carriageway" and "Small Lot Frontages"
32	Insert new pages 32.A and 32.B
33	Flag "For a Single Lane Carriageway" and "Two Lane Carriageway"
34	Flag "Carriageway Lanes Concept"
35	Flag "Carriageway Width"
35	Flag Figure 2.6.F, and 'box' 5.5 in 3rd column (Car/moving car at 30km/h) instead of 5.5 in 4th column.
36	Flag Figure 2.6.G, and add note as per page 36.A of Commentary.
36	Insert new page 36.A
41	Utility Services 2nd para, 1st line - delete "d" at end of "accommodate(d)"
41	Flag "Minimum Verge Width"
42	Flag "Vehicle Access to lots"
42	Insert new page 42.A
43	Flag "Minimum Verge Width" and add "at any point"
43	Flag Figure 2.8.F
44	Insert new page 44.A
45	Flag "Minimum Reserve Widths" and add "at any point"
45	Flag "Average Reserve Width"
47	Flag "Sight Distance"
47	Figure 2.10.B - Emphasise dimension arrows
47	Flag "Grades"
47	Flag "Crest Curves"
47	Flag Table 2.10.C and amend "44m" to 100m"

QUEENSLAND STREETS

Updating of May 1993 Edition

Page Nº	Amendment
48	Flag "Sag Curves"
48	Flag "Carriageway Cross-Section"
50	Insert new pages 50.A and 50.B
51	Flag "Speed 20 km/h" curve
52	Flag Graph Title and add "Absolute" ... Minimum
52	Insert new pages 52.A and 52.B
53	Flag Graph Title, and add "Absolute" ... Minimum
56	Flag "Types of Intersection"
57	Figure 2.11.B - Delete fourth "southern" leg on Plan.
58	Flag "Entry Treatment"
58	Flag "Roundabouts"
58	Insert new pages 58.A and 58.B
60	Flag "Design Vehicles"
60	Flag "Single Movement Facility"
60	Flag "Figure 2.12.B"
60	Insert new pages 60.A to 60.G
61	Flag "Three Point Turn" and "Figure 2.12.C"
62	Flag "Need for Devices"
62	Flag "Design Requirements"
62	Flag "Appropriate Devices"
63	Flag "Central Median"
63	Flag "Figure 2.13.A"
64	Insert new pages 64.A to 64.D
65	Flag "Trunk Collector Street" in Table.
65	Amend "Trunk Collector Criteria" in Table:- - Carriageway Width "9.0m" in lieu of 8.0 - Add Footnote reference (5) after "4.5m" (verge) and "20m" (reserve) - Footnote reference "(3)" in lieu of (8), and "(4)" in lieu of (9)
65	Add new Footnote: "5. Additional Verge and Reserve width required for footpaths/ cyclepaths. See new Figure 3.7.C"
70	Flag "Connectivity"
72	Flag "Bus Routes"
75	Flag "Economy"
75	Flag "Standards"
78	Flag "Connectivity and Permeability"
78	Flag "Legibility"

QUEENSLAND STREETS

Updating of May 1993 Edition

Page №	Amendment
80	Insert new pages 80.A to 80.E
82	Flag "Route Location"
82	Flag "System Components"
83	Flag "Particular Cases - Crossing Points"
84	Flag "Major Road System - Dual Use Paths"
85	Flag "4.7 Physical Design Standards"
86	Flag "Cyclepath/Dual Use Path - Path Width"
86	Insert new pages 86.A and 86.B
89	Flag "Recommended Profiles"
89	Flag "Service Allocations"
90	Flag "Stormwater Drainage"
90	Flag "Signs and Pavement Markings"
92	Insert new pages 92.A and 92.B
95	Flag "Sub-Arterial Road - Characteristics"
96	Flag "Standards"
97	Flag Figure "Sub-Arterial Road - Alternative Cross-Sections"
100	Insert new pages 100.A and 100.B
104	Insert new Sections: (where purchased separately) • 8.0 "Rural Residential Streets" • 9.0 "Industrial Streets" and • 10.0 "Multi-Unit Residential Streets"
105	Amend Section "8" to Section "11"
105/107	Re-number pages to "505, 506, 507"

CONTENTS

CONTENTS

COMMENTARY

The **"Commentary Pages"** herewith are issued for insertion into the First Edition of "Queensland Streets", dated May 1993, and are intended to be read in conjunction with the text of the original publication.

These pages contain further explanation on some aspects, and comments and suggestions on the practical application of the "Guidelines", based upon feedback from industry professionals and experience gained in application to real-life development.

A future full revision of the Guidelines will incorporate the contents of these pages into the document text.

ADDITIONAL SECTIONS

The following additional Sections are currently in preparation, and will be available in the near future:--

- **RURAL RESIDENTIAL STREETS**
- **INDUSTRIAL STREETS**
- **MULTI-UNIT RESIDENTIAL STREETS**

PRODUCTION

The **"Commentary Pages"** and the **Additional Sections** are:-

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1.4 CONTENTS AND APPLICATION

The application of the Guidelines to various densities and forms of residential development requires some clarification. Recommended application is:-

- **"Conventional" Detached Residential**
  eg Lot frontage 17m to 25m,
  Areas 600m² to 1200m²

  Apply Guidelines without modification.

- **Large Lot Detached Residential**
  eg Lot frontages 25m to 35m
  Areas 1200m² to 2000m².

  Apply Guidelines, but check that the travel time in the speed-restrictive environment does not exceed 90 seconds. If so, see **Rural Residential** recommendations.

- **Rural Residential**
  eg Lot frontages 40m and over
  Areas 2000m² and over.

  Apply **Rural Residential** guidelines (to be issued shortly).

- **Small Lot Residential**
  Including Detached, Zero lot line and Duplex.
  eg Lot frontage 12m to 17m,
  Areas 250m² to 600m².

  Apply guidelines, but modified to provide additional provision for passing, parking and/or reduced traffic volume in accordance with Section 2.5 (including Commentary.).

- **Multi-Unit Residential**
  (All forms)

  Apply **Multi-Unit** recommendations (to be issued shortly).

1.8 ALTERNATIVE DESIGN CONCEPTS

PLANNING PHILOSOPHIES

A number of alternative neighbourhood design concepts have recently been promoted both overseas and in Australia, with titles such as:-

- **Traditional Neighbourhood Development** (TND)
- **Neo-Traditional**
- **Transit Orientated Development** (TOD)
- **Transit Supportive Communities**
- **Urban Villages**

The basic aims are generally improved liveability with greater energy efficiency, and typical features include:-

- **Higher development density**
- **Greater mix of land uses**
  (eg Housing/retailing/offices)
- **Reduced dependency on motor vehicles** and enhanced pedestrian and public transport use.
- **Clear community focus,** (often Transit/ Commercial based).

The **Planning** aspects of these philosophies are outside the scope of these Guidelines, but it may be noted that the recommendations herein recognise and endorse many of the principles inherent in these philosophies, such as:-

- The trend to **Higher Urban Densities** (reduced allotment and street reserve areas)
- Provision for **Public Transport** (bus routes)
- **Pedestrian and cycle** routes with high connectivity
- Good **Access to Neighbourhood Facilities**

STREET DESIGN

While there may be no major differences of opinion on overall Planning Objectives, this is not the case when it comes to detailed **Street Layout and Design**.

In some of these concepts there is advocacy of a return to the traditional **"Grid-Iron" street layout**, typically a dense grid of straight and parallel streets, intersecting a similar system at 90°. There are no cul-de-sacs, virtually all streets are of equal traffic significance, and there are numerous connections to the external road system. In essence, the Planning aim is to re-create the street activity and social interaction of the **traditional "Main Street"**, while from a traffic viewpoint providing maximum vehicular convenience.

This approach may well be appropriate in the denser **"Central Core"** of development, which may vary in scale from a Neighbourhood Centre, to a Town or Urban Village Centre, or Metropolitan CBD, and which may be either essentially Commercial in nature, or "Mixed Use". However the "Grid-Iron" street pattern is considered to be quite **inappropriate** in the surrounding essentially **Residential** areas, of whatever development density.

The inherent **problems** of the "Grid -Iron" system in this context are:-

- **Traffic Volumes** are unpredictable. Internal Traffic will follow the "line of least resistance", while the system will also be subject to "rat-running" by external traffic. Inevitably, some streets will carry traffic volumes well above desirable levels.

  Either all streets must be designed for "higher than average" volume, or there may be future Local Government costs for upgrading capacity and/or for L.A.T.M schemes - the very problem which has plagued most urban Local Government in the last decade. This aspect is therefore detrimental to **Amenity, Safety and Economy.**

- **Traffic Speed** is encouraged by the typically long, straight and (necessarily) wide carriageways. The only means of controlling speed is a multitude of Speed Control Devices (detrimental to **Safety, Amenity and Economy**).

- **Intersections** are typically 4-way, and considerably greater in total number than in a "branching" system, greatly increasing the accident potential, and requiring signalisation for higher traffic volumes (detrimental to **Safety and Economy**).

However, the "Grid-Iron" system does have an inherent advantage in **Convenience.** A driver or pedestrian may select the shortest route between trip origin and destination, or vary the route if traffic conditions dictate. The layout also can provide a high degree of **legibility**.

For Residential Streets it is considered that the **"fully branching, hierarchical"** street system as recommended in the Guidelines is superior in **Safety, Amenity and Economy** and is therefore more appropriate than the Grid-Iron system. However, to alleviate or minimise the potential for reduced **Convenience** the following points (which are all detailed in the text) should be carefully addressed:-

- **Pedestrian and Cyclist connectivity** of a high order should be provided.

- **Legibility** of street layout should be considered, and augmented if necessary by intersection design.

- **Internal Connectivity** within the Neighbourhood ("Urban Village" or whatever) should be designed such that Community facilities, schools, shops, transit facilities etc can be readily accessed **without** the need to use the external Major Road system. This will enhance the notion of "community", and the sense of integration of the neighbourhood.

- **External Connections** to the Major road system should be located with regard to the major external traffic attractions, to minimise total travel time.

- **Bus Routes** should be carefully considered, and provided for as appropriate.

- **Future Street Link Options** should be provided for where appropriate. A means of achieving this may be by dedication of the street reserves, presently left as open space, but with provision for future street construction if required.

GENERATION RATE

The variation of **trip generation with traffic catchment**, as shown in the example of Figure 2.2.D, requires clarification.

The **Trips/House/Day** as shown in the Figure indicate the traffic counts recorded at the **catchment boundary**. In each catchment, regardless of catchment size, the trips per day generated by the individual house should be approximately the same, but the larger the catchment, the more trip ends will tend to be **within** the catchment, and hence the less the traffic generation at the catchment boundary. eg, for the largest catchment shown in the Figure (Discovery Drive, Helensvale) it could be assumed that the average generation per house is 10 trips/day, of which 5.5 trips are within the catchment (shops, schools) and only 4.5 trips outside the catchment, as indicated by the recorded count.

For **Traffic Volume** calculation at any point in the street or road system, the **"external" traffic** generation of the upstream catchment at that point is the relevant volume.

For **Residential Streets** the significant range of catchments is **75 to 300 lots** (limits for Access and Collector Streets respectively). Typically a catchment of this size will have limited internal traffic generation, perhaps a Convenience Store or small shopping centre. Inspection of Figure 2.2.D indicates that for the examples shown a generation of 10 trips/house/day is a reasonable, if conservative assumption, within the 75 to 300 lot range.

SPEED RESTRICTIVE DESIGN

The principal design means for achieving speed limitation in residential streets are either:-

- **Limiting "street leg length"**, or
- **Curved alignment**

Particularly for **Access Streets and Places**, designing a continuously curved alignment is difficult due to the tight radius required (30m maximum radius, for 30 km/h). Hence for these lower speed streets, **limiting the street leg length** is the most common means of achieving speed limitation criteria.

Other than in the case of a short cul-de-sac, where the total street length can be limited, this usually means introducing a **sharp bend** (eg 90°) in the alignment, or some form of speed control device.

The ideal is for **Speed Control Devices** to be used **as sparingly as possible** due to their cost and possibly intrusive nature, and hence it is **essential** that speed control requirements be considered from the inception of the subdivision layout design process, to maximise speed control by street alignment.

STREET LENGTH

The relationship of **Street Length and Design Speed** shown in Figure 2.3.B assumes "End Conditions" of 20 km/h.

However recent research indicates that **Intersection Speeds** and **Speed Control Device Speeds** both of which have generally been assumed to be 20 km/h, are in practice somewhat greater, perhaps **25 km/h**.

In any case, in newer Residential areas, driver reaction is generally that 20 km/h is too restrictive, particularly where the Design Maximum Speed is 40 or 60 km/h.

For 25 km/h "End Conditions", from Table 2.3.D, either:-

- **Street Leg Lengths** to achieve a particular design maximum speed will necessarily be less, eg:-
  - 30 km/h - 45m in lieu of 75m
  - 40 km/h - 100m in lieu of 120m
  - 60 km/h - 165m in lieu of 180m

or

- **For a Given Leg Length** the actual **Street Speed** will be **greater** than assumed, approximately **10 km/h** in each case.

Until more definite data is available it is recommended that the design criteria in the Guidelines continue to be used. However, bearing in mind that "real-life" vehicle speeds may exceed the Design Speeds, any variations should be on the conservative side.

However, for a cul-de-sac, where the end of the street is clearly visible, the "End Condition" may be assumed to be zero km/h, and the last Leg Length increased, say from 75m to 100m.

BENDS OR CURVES

Table 2.3.C in the Guidelines suggests **Curve Radii** appropriate for restriction of vehicle speeds to selected values.

However a vehicle may follow a path through a bend with a **radius considerably greater than the actual centre-line radius** of the carriageway. The difference between the two radii can vary with the carriageway width, the deflection angle, and the radius. An approaching vehicle, parked vehicles, or restricted visibility may modify the vehicle path closer to the centreline radius. The potential variation between the two radii may also have been incorporated to some extent in the original observed data.

However, it is evident that the lower limit of deflection angle suggested in the Guidelines (60°) is too liberal, and the following **alternative** approaches are suggested:-

- **Minimum Deflection Angle**
  5.5m or 7.5m carriageway - 90°
  or
- **Reduced Radius**
  or
- **Median Strip** through the bend or chicane as described in Commentary - Section 2.13.

SPEED ENVIRONMENT

It should be noted that in addition to the geometric design measures quoted, attaining a **lower "speed environment"** can be greatly assisted by visual reinforcement such as trees or heavy landscaping in close proximity to the carriageway, particularly on the inside of bends, in Central Medians, and at the ends of straight sections. However, the effects of such visual measures are not readily quantifiable.

PARKING WITHIN ALLOTMENTS

"TANDEM" PARKING

When assessing compliance with on-site parking requirements, Councils vary in their acceptance of "tandem" parking, ie parking of an additional vehicle on the driveway between the garage or carport and the kerb.

Relevant factors include:-

- Verge width (minimum 3.5 m for Collectors, 3.0m for Access Places and Streets).
- A parked vehicle should not encroach onto the carriageway.
- Pedestrian movement on the verge should not be unduly obstructed - ie a constructed footpath should not be obstructed, or where there is no constructed path a pedestrian should be able to pass the parked car without leaving the verge.
- Garage door design (eg tilt-up), and perceived risk of damage, may inhibit parking close to the door.

For the minimum verge widths, appropriate criteria for allowing "credit" for tandem parking are:-

- **Collector Streets**
  Setback of **6.0m minimum** to garage/ carport, from property boundary.
- **Access Streets and Places**
  Setback of **4.5m minimum** to garage/ carport, from property boundary, **provided** that there is no likelihood of the street requiring a footpath/ cyclepath in which case the minimum setback should be **6.0m**.

If the **verge width is greater** than the recommended minimum, the relevant minimum set-backs may be reduced by the distance by which the actual verge width exceeds the minimum.

PARALLEL PARKING REQUIREMENT

SMALLER ALLOTMENTS

In combination with narrower carriageways, the trend to smaller residential allotments has significant implications for street design, particularly in regard to **Parking**, and resultant **Passing Opportunity.**

Salient points are:-

- **Reduced Allotment Area and Building Setbacks** reduce the possible capacity for parking within allotments.
- **Reduced Allotment Frontages** reduce the potential kerb parking capacity per lot substantially and suddenly when frontage is reduced below about **17m** and again at about **12m.**
- **Greater Kerb Length** (approx 7m) is required for vehicles to access driveways on narrower carriageways, reducing potential kerb parking, regardless of allotment frontages.

The potential problems from reduced allotment frontages are most significant on **Two-Lane Carriageways,** as on Single-Lane carriageways parking and passing provision must in any case be specifically designed, while on Three-Lane carriageways the opportunity for random kerbside parking on both sides of the street reduces the potential problem.

The special measures required on Two-Lane Carriageways are set out in Section 2.5, and additionally in **Commentary 2.5.**

SUPPLY OF PASSING OPPORTUNITY

SINGLE LANE CARRIAGEWAY

A single-lane carriageway with designed passing and parking bays is a valid theoretical option.

However in practice it has proved to be **not** popular with:-

- **Councils**, due to possible future resident complaints, and perceived refuse collection problems.
- **Developers**, due to perceived market resistance from potential land purchasers, and as there is no real construction cost saving, the more complicated geometry offsetting carriageway area reduction.
- **Designers**, due to the more complicated design required.

Hence it is unlikely that this option will be proposed, at least at the present time, other than perhaps for short "driveways" serving a very limited number of lots. Nevertheless, further familiarity with its use in Group Title developments may result in greater appreciation of its aesthetic advantages, and hence greater utilisation in the future for public streets.

TWO LANE CARRIAGEWAY

SMALL LOT FRONTAGES

Designed Passing Places

The simplest method of providing "Designed Passing Places" is probably by using **Central Medians** which then also serve as Speed Control Devices.

Since the required passing capacity in this case is only to supplement random passing opportunity, a spacing in accordance with Figure 2.5.D, but with a **spacing of not less than 50m** is probably reasonable.

However it should be noted that provision of **additional** combined Passing/Speed Control devices may compound the parking problem, by still further reducing parking opportunity.

Note that the longitudinal axis of Figure 2.5.D is the **Number of Lots** in the traffic catchment, and the vertical axis should read "**Maximum Spacing...**".

Mixed Lot Frontages

Interspersing smaller frontage lots (eg 13-15m) between lots of "conventional" frontage (eg 17m) will assist in retaining passing opportunity. However the spacing of the larger frontages needs to be appropriately close, say every third lot.

Reduced Traffic Catchment

While the approaches of **Additional Parking** and **Designed Passing** both aim at increasing passing opportunity, a further approach is to reduce the demand for passing opportunity by reducing the **traffic volume**.

However this approach is probably not appropriate for the smaller frontages, where excess parking may totally impede moving traffic, irrespective of the traffic volume.

Fairly arbitrarily, the following is suggested:-

Allotment Frontage (m)	Maximum Traffic Catchment (Lots)
17	75
16	65
15	50

FIGURE 2.5.G

Widen Carriageway

Yet a further option is to provide a **Three-Lane Carriageway** (7.5m) for the whole section of the street where frontages are less than 17m, to provide more parking and passing opportunity, and improved lot access.

Frontages Less than 12m

Where lot frontages less than 12m are proposed, special design measures are required to provide for adequate parking, passing, and allotment access.

Options could include rear garages and access with no driveways on the frontage, or **all** parking provided in off-carriageway bays, and / or widening the carriageway to three lanes.

CARRIAGEWAY LANES CONCEPT

FIGURE 2.6.G

Although explained in the text, a note should be added to the Figure:-

"At any point the Carriageway Width must be an **exact number of lanes**, and be the appropriate **width for those lanes**:

ie

One Lane	-	**3.5m**
Two Lanes	-	**5.5m**
Three Lanes	-	**7.5m** "

CARRIAGEWAY WIDTH

"AMBIGUOUS" WIDTHS

It is emphasised that the recommended carriageway widths should **not be exceeded**, due to the risk of ambiguity in the number of traffic lanes intended.

From experience, a width of **6.0m** can result in a "de facto" three-lane carriageway with two cars parking opposite each other in the belief that a moving vehicle can pass between them.

Similarly, for a **4.0m** carriageway, an intended single-lane carriageway could encourage parking, and become a de facto two-lane carriageway, while a width of **8.5m or 9.0m** can be a defacto four-lane carriageway, with two moving vehicles attempting to pass between two parked vehicles.

Note that the wrong "5.5" is boxed in Table 2.6.F. The relevant figure is the 5.5 for "Car / Moving Car" at 30 km/h (Two-lane Access street).

SIMPLIFIED SUMMARY OF ACCEPTABLE SOLUTIONS

The Guidelines seek to give a valid theoretical background for the recommendations on Carriageway Widths and Traffic Catchment limitations, and to offer a range of options for design.

However, a summary of the simplest application of the recommendations is:-

TWO-LANE CARRIAGEWAY:

Width 5.5m
75 lots maximum

Lot Frontages 17m or above:

No special parking or passing provision.

Frontages less than 17m, but not less than 12m.

Four Options, as follows:

- **Additional parking**, clear of two-lane carriageway, in accordance with Table 2.5.E.
- **Designed passing places,** in accordance with Commentary - Section 2.5.
- **Reduced traffic catchment** in accordance with Commentary Section 2.5 - Figure 2.5.G
- **Widen carriageway** to three lanes.

THREE-LANE CARRIAGEWAY:
Width 7.5m
300 lots maximum

No special provision for smaller lot frontages, unless less than **12m,** when special design required (see Commentary Section 2.5).

VERGE

MINIMUM VERGE WIDTH

It must be emphasised that both the **Minimum Verge Widths** (and the **Minimum Reserve Widths**) quoted as Acceptable Solutions are the **Minimum Widths** appropriate **at any point** in the street length.

A greater **Average Verge Width** is necessary to provide adequate visual amenity, and opportunities for landscaping.

Desirably, both the Verge width and the Reserve width will vary throughout the street length. For the Average Reserve Widths quoted in Section 2.9, viz: 14.m for Access Places and Streets, and 16m for Collector Streets, the **Average Verge Widths** would be:-

- **Access Places and Streets (carriageway 5.5m) 4.25m**
- **Collector Streets (carriageway 7.5m) 4.25m**

If a uniform cross-section were to be adopted throughout the street length, these **average** verge widths would also be the **minimum widths**.

VEHICLE ACCESS

Compared to "traditional" streets, the reduced carriageway widths result in less cut and fill across the street cross-section, assisting vehicular access to allotments. However, this may be more than offset by reduced verge widths, combined with possible reduced (or zero) building setbacks to garages, possibly resulting in greatly **reduced distance** in which to accommodate differences in level.

The **grade changes at garage entrances** may need to be checked for car clearance, and on steep longitudinal street grades the levels at the **driveway edges** require checking, due to the necessary "warping" of the driveway between the level garage floor and the grade at the kerb.

If necessary, garages on the high side of the street may have to be cut into the slope, and those on the lower side built up.

For integrated "land/house" development **co-ordination** of street and building design is obviously **essential.**

It is also essential to ensure that every allotment has a suitable access location, clear of potential obstructions such as Speed Control Devices, Gully Pits, etc.

VERGE CROSS-SECTION

The Minimum Verge Cross-Section, as shown in Figure 2.8.F is still valid for the following:-

- **Amended Kerb and Channel Profile**, as recommended in Commentary Section 5.1.
- **High Side of One-Way Crossfall Carriageway** "against the ground cross-slope" (see Figure 2.10.E(B)) ie carriageway fall **away** from the kerb.

The critical situation is the centre clearance for a long wheelbase car when one wheel is in the channel. Provided that the relative height of the high point of the verge above the channel is not increased, the above two variations will not affect the clearance.

To make the cross-section levels independent of kerb profile, they are better related to the **channel lip** rather than the top of kerb. Levels on Figure 2.8.F are then:-

Front of path	+	185mm	
Back of path	+	215mm	
RP Boundary	+	315mm	(rising)
	+	165mm	(falling)
1.5m inside RP	-	85mm	(falling)

STREET RESERVE WIDTH 2.9

MINIMUM RESERVE WIDTH

As discussed in Section 2.8 Commentary, the Minimum Reserve width is the minimum width at **any point** in the street length, being the sum of the carriageway width plus twice the "Acceptable Solutions" Verge width recommendation.

Both verge and reserve widths should desirably vary throughout the street, the **Average Reserve Width** being not less than the "Acceptable Solutions" recommendation.

AVERAGE RESERVE WIDTH

The recommended **Average Reserve Widths** are based on keeping the area of land required for streets to the practical minimum, consistent with satisfactorily fulfilling the performance criteria for the street.

However, in localities where land values are relatively low and there is a market expectation of more spacious development, it is appropriate to **increase** both the verge widths and the reserve widths. This extra width is beneficial in reducing the constraints of locating services and footpaths within the verge, providing additional area for effective landscaping, and providing greater visual separation between the residences on opposite sides of the street.

It is considered that in such cases the actual width criteria should be determined by the Council, based on assessment of the relative local importance of **Amenity and Economy**. However, rarely would average Reserve Widths greater than **20m for Collector Streets and 18m for Access Places and Streets** be appropriate.

The **upper limit** to extra verge width may be the willingness of residents or the Council to accept the additional maintenance obligation.

HORIZONTAL ALIGNMENT

SIGHT DISTANCE

It is emphasised that the required Sight Distance on horizontal curves is measured along the **vehicle path**, which may be assumed as the **carriageway centreline, not** along the chord as is usual highway design practice. For the relatively sharp curve radii under consideration the difference in the resultant truncation is significant (Figure 2.10.B).

GRADES

No "**Absolute Maximum**" grade for Access Places and Access Streets is quoted in the text, as local acceptance of steeper grades is dependent somewhat on the topography of an area. However, it is considered that **20%** as quoted in the "Acceptable Solutions" may be an appropriate absolute maximum.

Where a future **Bus route** is identified (on a Collector Street or higher order Street / Road) the grade should be kept to the minimum reasonably attainable, with perhaps **10%** as the absolute maximum.

VERTICAL ALIGNMENT

CREST CURVES

For very sharp radius crest vertical curves the sight distance will be limited by the driver's line of sight over the car bonnet, rather than by the road geometry. While this will vary considerably with the driver's eye height and the car design, a V.C. radius of about **100m** could be the approximate limit.

It is therefore recommended that:-

- **In Table 2.10.C**
  100m be substituted for 44m

- **In Figure 2.10.G**
  Curve for "Speed 20 km/h" be deleted, and 25 km/h curve be marked "**and 20 km/h).**

SAG CURVES

The minimum values for sag vertical curves, based on **Headlight Sight Distance**, as given in Table 2.10.D and Figure 2.10.H should desirably be amended. The criteria in the Guidelines are derived using an assumed headlight beam elevation of 1° above the horizontal rather than the current Austroads assumption of a **zero elevation.**

Based on the latter assumption, minimum radii are:-

Speed	**Curve Radius**
20 km/h	70 m
30 km/h	250 m
40 km/h	600 m
50 km/h	1050 m
60 km/h	2000 m

As these amended criteria may be difficult to achieve in many situations, they may be considered as **Desirable** criteria, with the previous recommendations as **Absolute Minima.**

Amended Graphs, Figures 2.10.H(a) and 2.10.J(a), are attached.

INTERSECTION VERTICAL CURVES

For the special case of vertical curves on the non-priority streets adjacent to an intersection (ie the leg of a 'T' intersection, or any street at a roundabout) the following criteria are applicable:-

- **Crest V.C.**
  Minimum crest V.C. in accordance with Figure 2.10.G for Stopping Distance 1.15m to zero. The **Speed** should be the **Design Speed** for the relevant street, unless the horizontal layout is such as to warrant a lower **Spot Speed** being adopted, or the vertical geometry is such that a driver can see the intersection before reaching it (eg "roller-coaster" approach).

  In such case, an **Intersection Speed** of 25 km/h may be assumed, and the V.C. length based on this speed.

  (Note: 25km/h provides the minimum Crest V.C. for bonnet sight line limitation).

- **Sag V.C.**
  In this case it may be assumed that the driver has visual warning of the intersection, and will slow to **Intersection Speed of 25 km/h.** It may also be assumed that the intersection will have adequate street-lighting, and in any case the turning vehicle path will largely negate headlight usefulness. Therefore **Comfort Criteria** will control.

  For 0.10g acceleration at 25 km/h, the **minimum** length of curve (m) per 1% change in grade ("K") is **0.50**
  eg for Change of Grade = 10%
  Minimum Curve Length = 5m

  However a **longer curve** should be used wherever possible, both for improved riding comfort and for appearance.

CARRIAGEWAY CROSS-SECTION

From consideration of the factors set out in the Guidelines, in most cases the appropriate carriageway cross-sections will be:-

- **Collector Street**
  Conventional centre crown
- **Access Places and Streets**
  One-way crossfall, **against** the ground cross-slope.

While one-way crossfall with the ground slope can improve vehicular access and intersection grading, there is a risk of flooding downhill properties due to cutting down of driveways, and a lack of facility for high-side house roof drains.

CARRIAGEWAY DRAINAGE

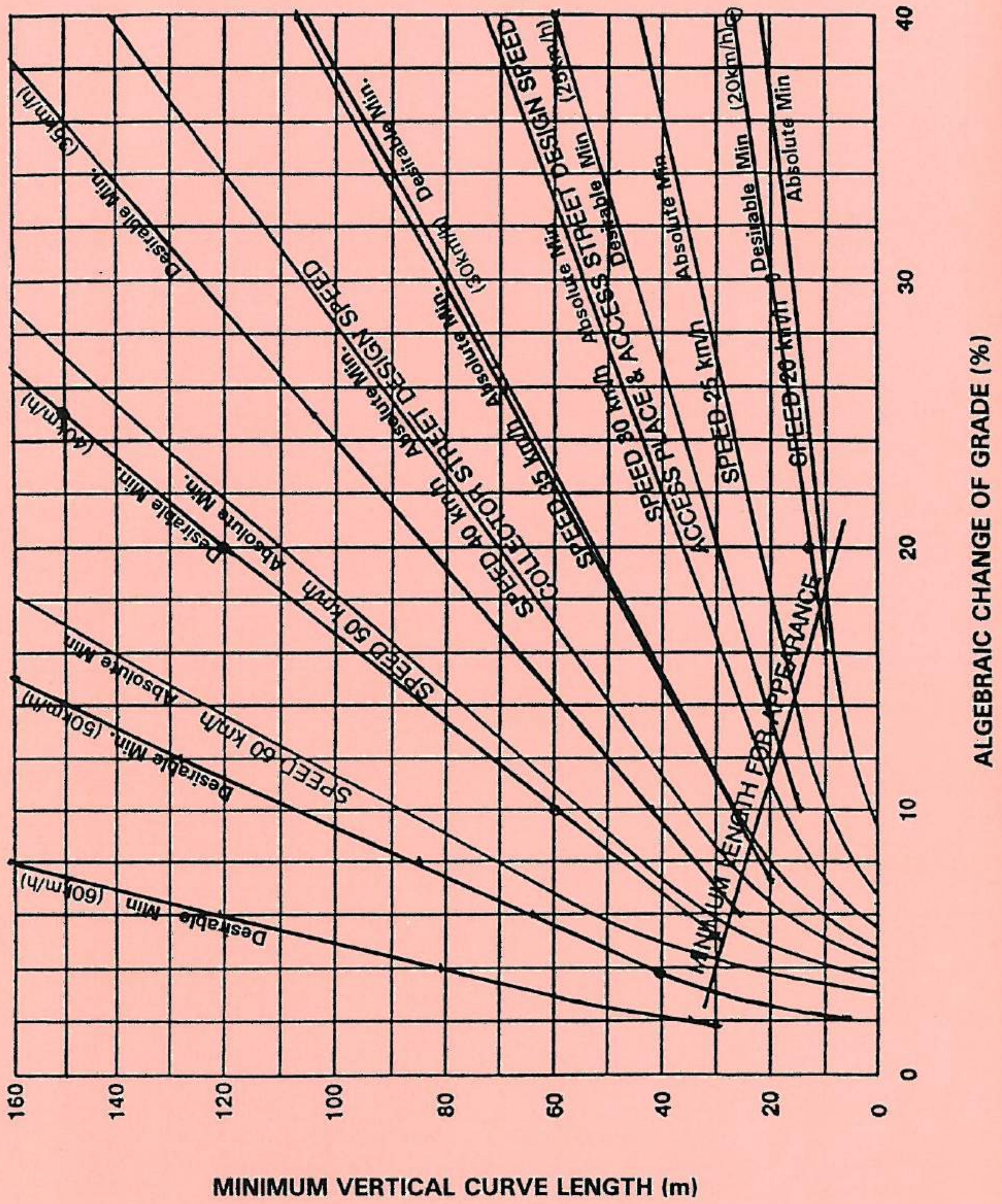
Detailed stormwater drainage design should conform generally with the recommendations of the "Queensland Urban Drainage Manual" (QUDM), considering both Access and Collector Streets as **"Minor roads"**.

Relating QUDM recommendations to the **channel lip**, rather than the top of kerb, to allow for possible amendment to the standard kerb and channel profile as recommended in Section 5.1 Commentary, appropriate carriageway flow limits for a **Minor Storm** discharge in the above recommended cross-sections are:-

- **Collector Street**
  Zero depth at the crown, or 115mm flow depth at the channel lip, whichever is the lower level (dependent on crossfall), and zero depth at 2.0m from the property boundary (ie lower edge of footpath).

- **Access Street** (One-way Crossfall)
  Maximum flow depth 115mm at low-side channel lip.

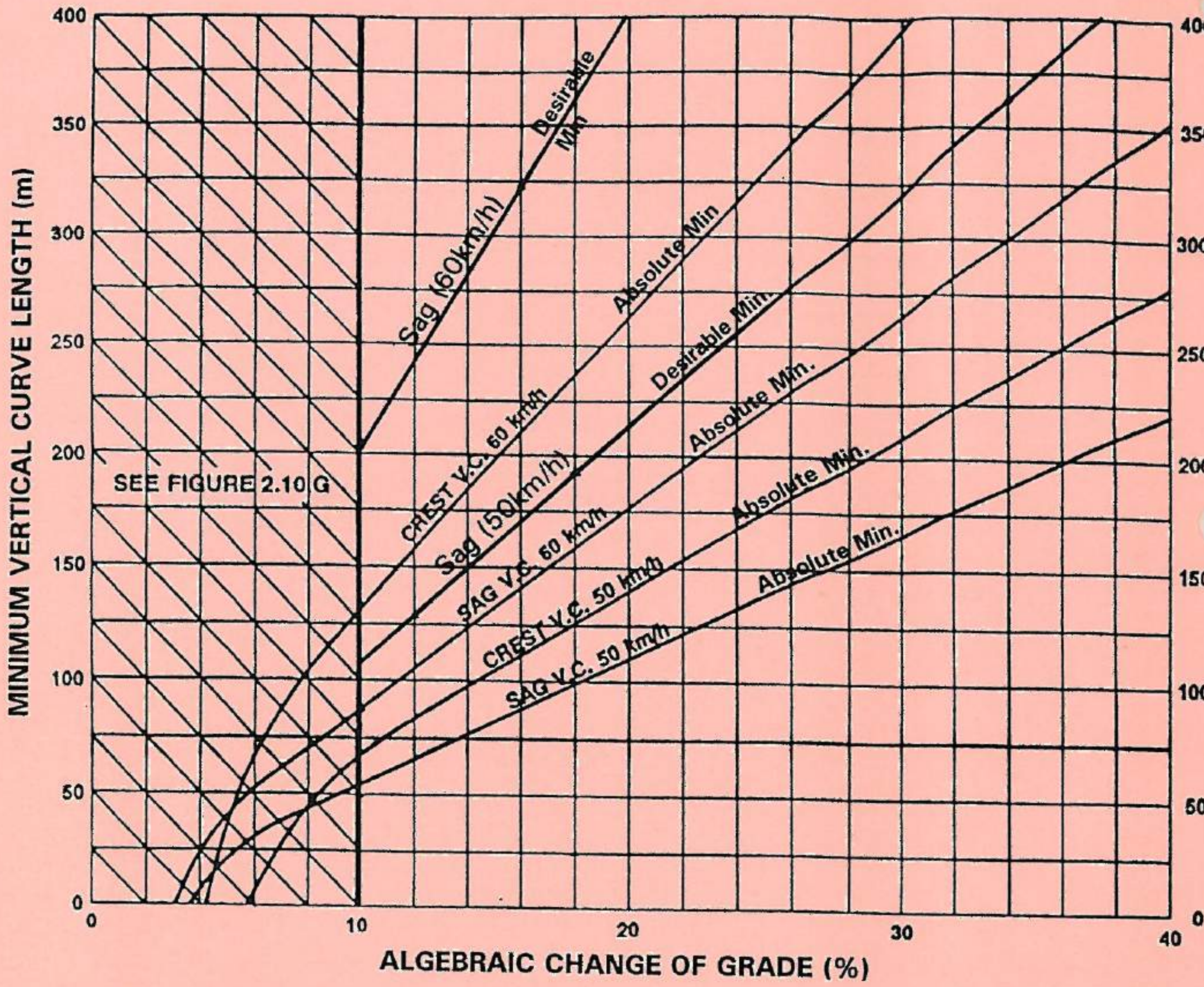
All other requirements for the **Minor Storm, and all Major Storm criteria**, should be in accordance with QUDM, noting particularly that where properties are below the street level the minimum verge level must provide a **minimum freeboard of 50mm above the Major Storm level.**



Curve lengths are "Absolute Minimum"
or "Desirable Minimum" as shown.

LENGTH OF SAG VERTICAL CURVE FOR STOPPING DISTANCE WITHIN HEADLIGHT BEAM

FIGURE 2.10.H (a)



Curve lengths are "Absolute Minimum" or "Desirable Minimum" as shown.

MINIMUM LENGTH OF VERTICAL CURVES FOR 50 km/h & 60 km/h DESIGN SPEEDS

FIGURE 2.10.J (a)

TYPES OF INTERSECTIONS

As noted in the Guidelines, uncontrolled four-way intersections should **not** be used, nor is signalisation justifiable by traffic volumes in a Residential area.

Hence, the example shown in Figure 2.11.B should be a **T-Junction**, not a Four-Way intersection as shown.

T-JUNCTIONS

ENTRY TREATMENTS

As noted, an "entry treatment", such as:-

- **Change of carriageway paving material**
- **Section of block paving, stamped concrete, or concrete strip**
- **Concrete dish drain**

can help to indicate a change of street status.

Such treatment can also assist the "**legibility**" of the subdivision layout, and reinforce **traffic priority**, by the major route continuing through the intersection without a change of pavement, while the minor streets have an appropriate Entry Treatment applied. Entry Treatment may also be applied where appropriate at Roundabouts.

Possible detail for a **Concrete Dish Drain** is shown in Figure 2.11.E.

ALLOTMENT LAYOUT

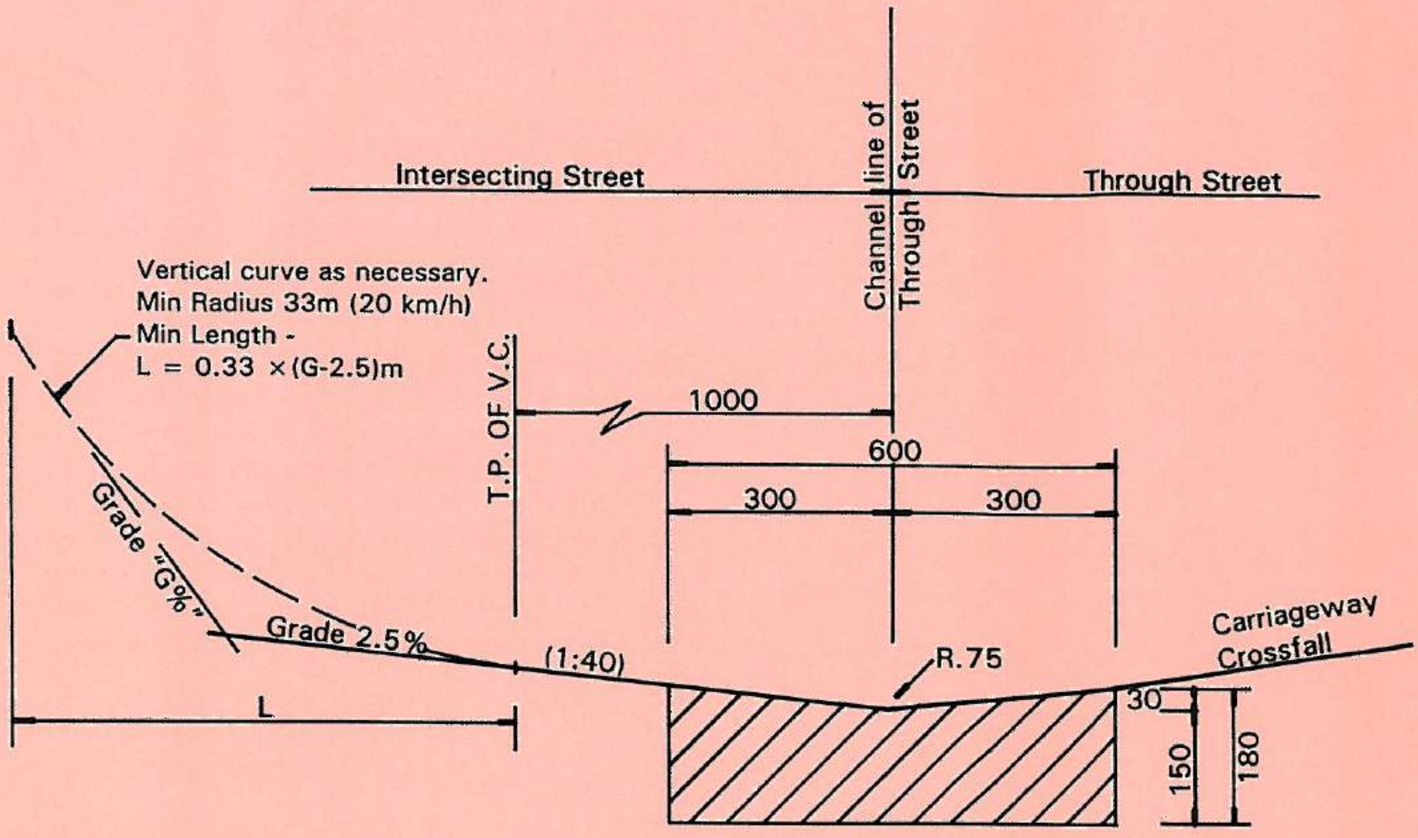
To minimise the nuisance from vehicle headlights it is preferable to locate an allotment boundary opposite the centre line of the intersecting street, rather than have one allotment centred opposite this street.

Better still, a pathway or park strip may be located opposite the street, thereby providing the appropriate pedestrian link and / or stormwater drainage function, as well as avoiding the headlight nuisance.

ROUNDABOUTS

The example shown in Figure 2.11.D has an external radius of 12m, based on allowing for all possible turns by a design heavy vehicle.

However, if provision need not be made for a heavy vehicle to U-turn (ie straight through, right or left turn only required), this radius can possibly be reduced, but with the vehicle path encroaching further into the central island. In the extreme, the entire central island may be made trafficable by a heavy vehicle, thereby however precluding possible provision for landscaping and / or signage within the island.



Note: Dish drain profile to conform to standard Channel Profile.

Not to Scale
(Grades exaggerated)

TYPICAL DISH DRAIN DETAIL

FIGURE 2.11.E

TURNING AREAS 2.12

GARBAGE COLLECTION

The major problem with the geometric design of cul-de-sac turning areas is the lack of standardisation between Councils,both in the **characteristics of their refuse vehicles,** and **policies on refuse collection**, eg:-

- Vehicle wheel base and turning circle
- Manual or mechanical bin pick-up
- If mechanical, one or both sides
- If manual, maximum carrying distance
- Limits on reversing vehicle
- Recycling, by the same or a different vehicle.

While individual Councils will necessarily select a Design Vehicle based on their particular requirements, they are urged to consider that the life of a street is 50 to 100 years or more, while that of a refuse collection vehicle may only be 10 to 15 years. It is therefore probably more logical to look at tailoring refuse vehicles to the desirable street geometry rather than vice versa. Several Councils are now using smaller vehicles, with turning geometry similar to the Brisbane City Council standard "**Medium Rigid Vehicle**" (MVR), for collection in streets designed in accordance with AMCORD and "Queensland Streets" principles. Councils (and/or Contractors) should also consider liberalising policies regarding reversing of vehicles in very minor streets, thereby allowing subdivision geometry such as shown in Figure 2.12.L.

SINGLE MOVEMENT FACILITY

The "**Three-Point Turn**" facility is considered to be generally preferable, due to its economy of land and carriageway area.

However, where the "single movement turn" is preferred, eg for easier garbage collection, there are a number of possible design options, all involving a compromise between the land area and paved area requirements on the one hand **(Economy and Amenity)** and turning **Convenience** on the other.

TURNING CIRCLE FOR CAR ONLY

A kerb diameter of **15m** will provide for a car or small van to turn in one movement, provided that there is no kerbside parking, but any larger vehicle must always use a three-point turn, as must a car if kerbside parking occurs. Provision of parking bays, to discourage kerbside parking, are highly desirable (see Figure 2.12.F).

TURNING CIRCLE FOR GARBAGE TRUCK

The required diameter is dependent on the particular Council's vehicle, but a diameter of **18m** will accommodate a smaller truck (similar to BCC "MRV").

Such a diameter will allow a car to turn if kerbside parking occurs on one side of the circle, but in such case the garbage truck will need a three-point turn. (see Figure 2.12.G).

CENTRAL ISLAND WITH PARKING

Provision of a central island improves visual amenity, but impedes three-point turning, where necessary for larger vehicles, or if parked vehicles prevent a single-movement turn by smaller vehicles.

However if sufficient formal parking bays are provided **either within the central island or in close proximity**, kerbside parking can reasonably be disregarded. In such case, an outer kerb diameter of 18m with 6m carriageway width should be appropriate for a "MRV" type garbage truck, and provides an island width suitable for parking (6m) (see Figure 2.12.H).

COMBINATION TURNING AREA

A possible compromise could be a turning circle of 15m radius for cars only, with specifically constructed "driveway extensions" to provide for larger vehicles to make a three-point turn (see Figure 2.12.J).

GENERAL DESIGN POINTS

Parking
For Turning Circle diameters less than about **18m** it is highly desirable that parking bays be provided somewhere in the vicinity of the cul-de-sac head, an appropriate rate of provision being **0.5 spaces per house** with restricted frontage width.

Entry and Exit Kerb Radii into and out of the turning area should be **15m minimum radius** to allow a turning vehicle to closely follow the kerbline, and thereby fully utilise the available turning area.

THREE - POINT TURN

SUBDIVISION LAYOUT

An advantage of the "Three-Point Turn" configuration for cul-de-sac heads is the ease with which it can be adapted to **rectangular allotment shapes**, rather than the "fan" shapes commonly used with circular heads. The rectangular shape is more efficient for smaller-lot development, particularly with "zero lot line" housing (see Figure 2.12.K).

A further option is to extend one or both "arms" of the turning area to serve a limited number of additional lots, as shown in Figure 2.12.L. In this example a car can turn in the driveways off the extension, but the garbage truck must back up the extension, or a centralised collection point be provided. Such a layout can be useful in subdividing an irregular shaped area.

TURNING AREA GEOMETRY

The turning areas shown in Figure 2.12.E are based on the NAASRA (now Austroads) Single Unit (SU) truck. However as previously noted, several Councils are now using smaller vehicles with turning geometry similar to the BCC "MRV".

Turning area layouts based on this design vehicle are shown in Figure 2.12.M.

In deriving turning area geometry care should be taken to use specific "**Manoeuvring Templates**" rather than "Turning templates".

For a **single-sided** mechanical pickup vehicle, it may be necessary to turn both ways, to pick up from both sides of each cul-de-sac arm. However, if the vehicle can pick up either side, or if there are frontages one side only, it is possible to design for turning one way only, resulting in an assymetrical layout, with some saving in pavement area. A further possibility could be to provide an area for **grouping of refuse bins** at a single location in the cul-de-sac head.

For safety, turning area geometry should if possible provide for the **backing movement** to be either straight or turning to the driver's side. This side will normally be the right, but in some dual-control vehicles the left side may be the normal driving side while collecting.

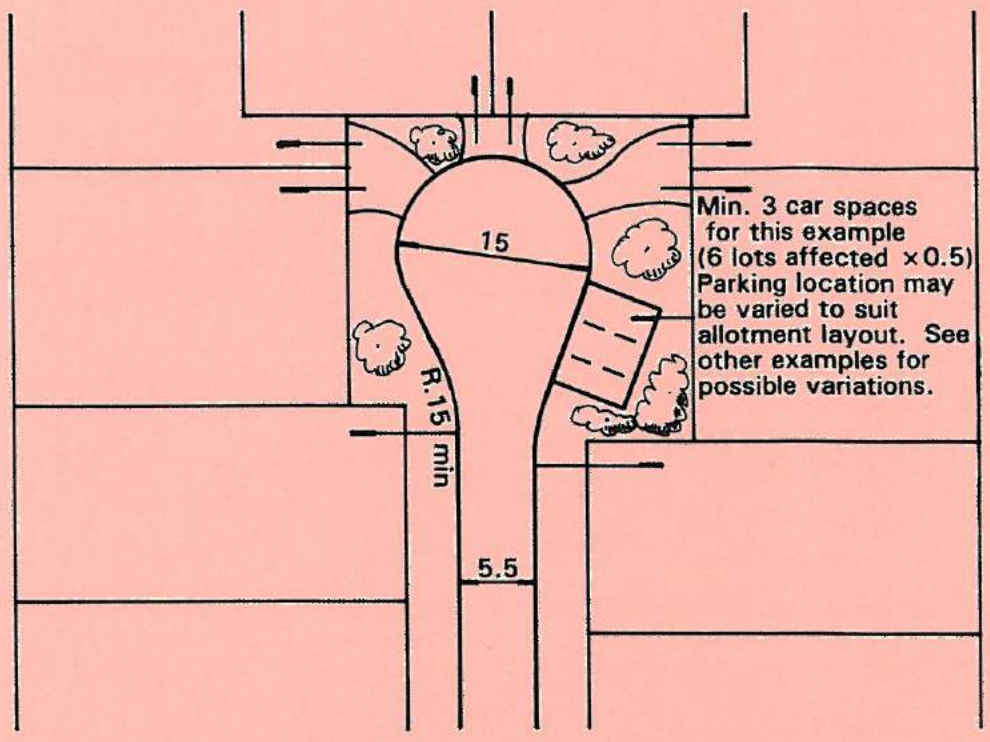
PARKING

Provision of parking bays adjacent to Three-Point-Turn turning areas is **virtually essential**, to avoid parking within the turning area, a ratio of **0.5 spaces per frontage lot** being again appropriate.

Parking bays should be in close proximity to the turning area (maximum 25m to allotments served) and in clear view of approaching traffic. Bays at the extreme end of a turning arm may be "appropriated" by adjacent lots. The amenity of lots adjacent to parking bays should be protected by planting / mounding.

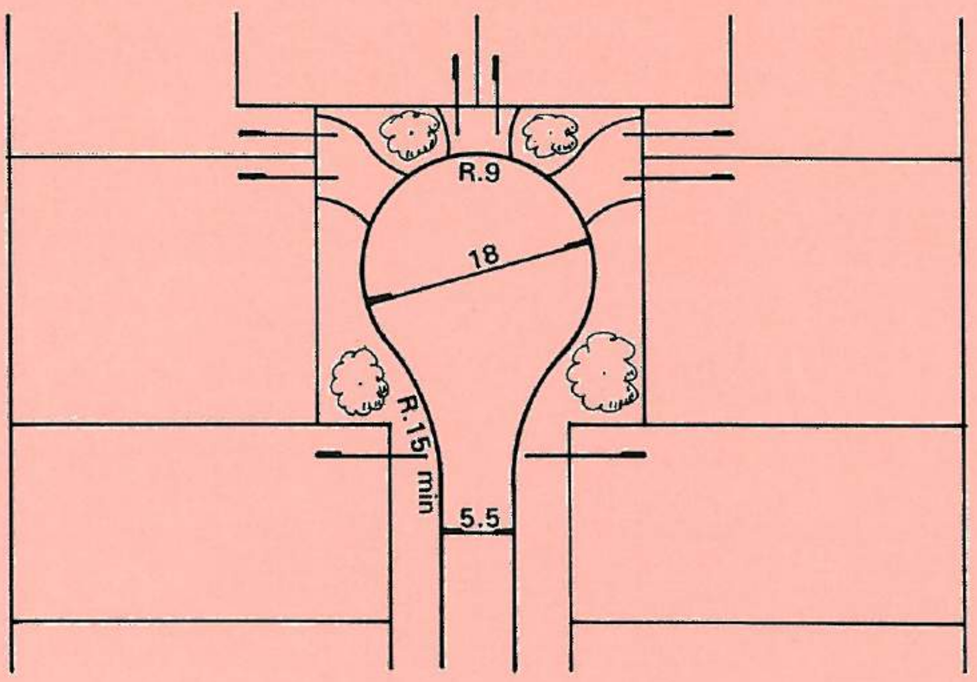
LARGE VEHICLES

In detailed design, the requirement for an **HRV** to turn within the street reserve, by mounting the kerb, should be considered in the location of street lighting poles and gully pits.



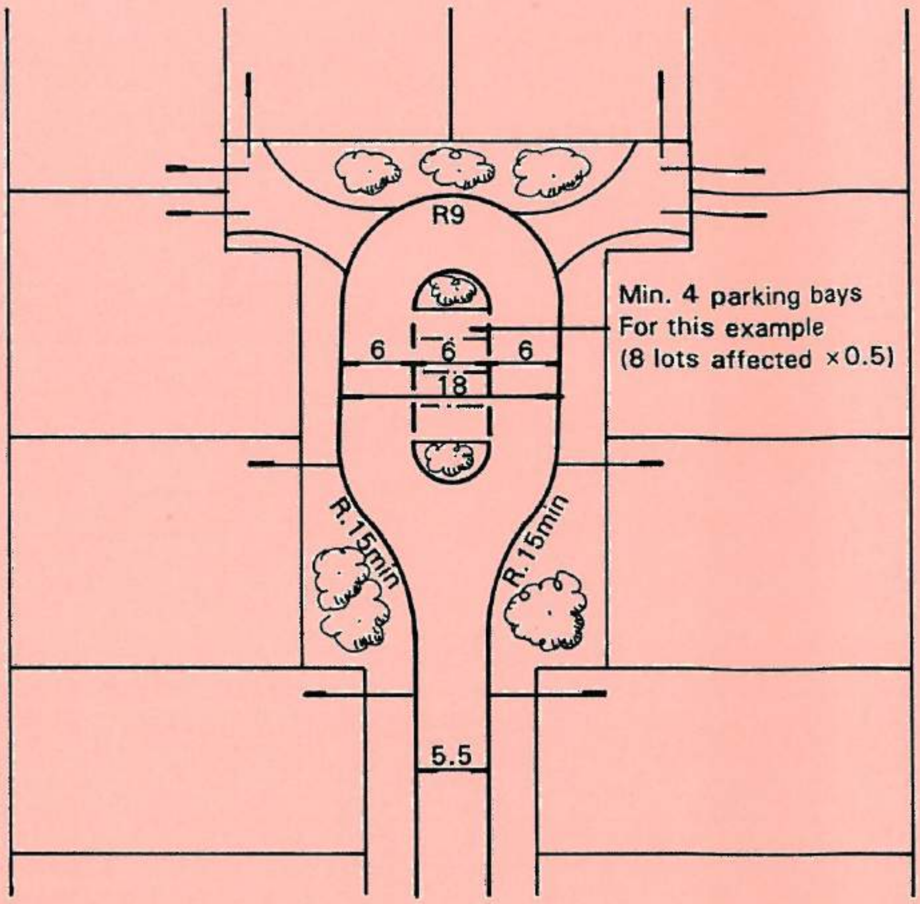
TURNING CIRCLE
15M. DIAMETER

FIGURE 2.12.F



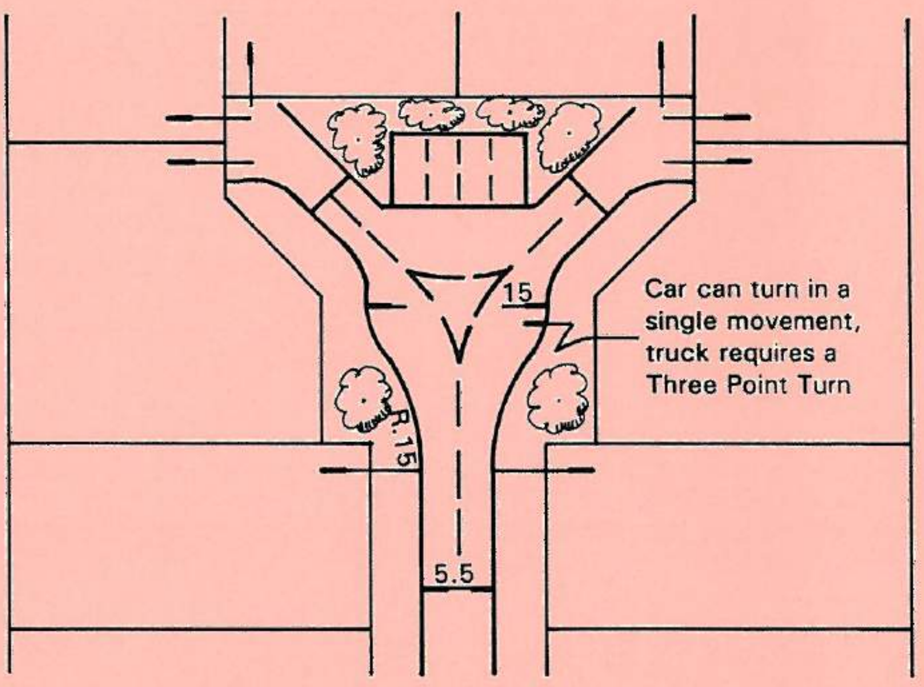
TURNING CIRCLE
18M. DIAMETER

FIGURE 2.12.G



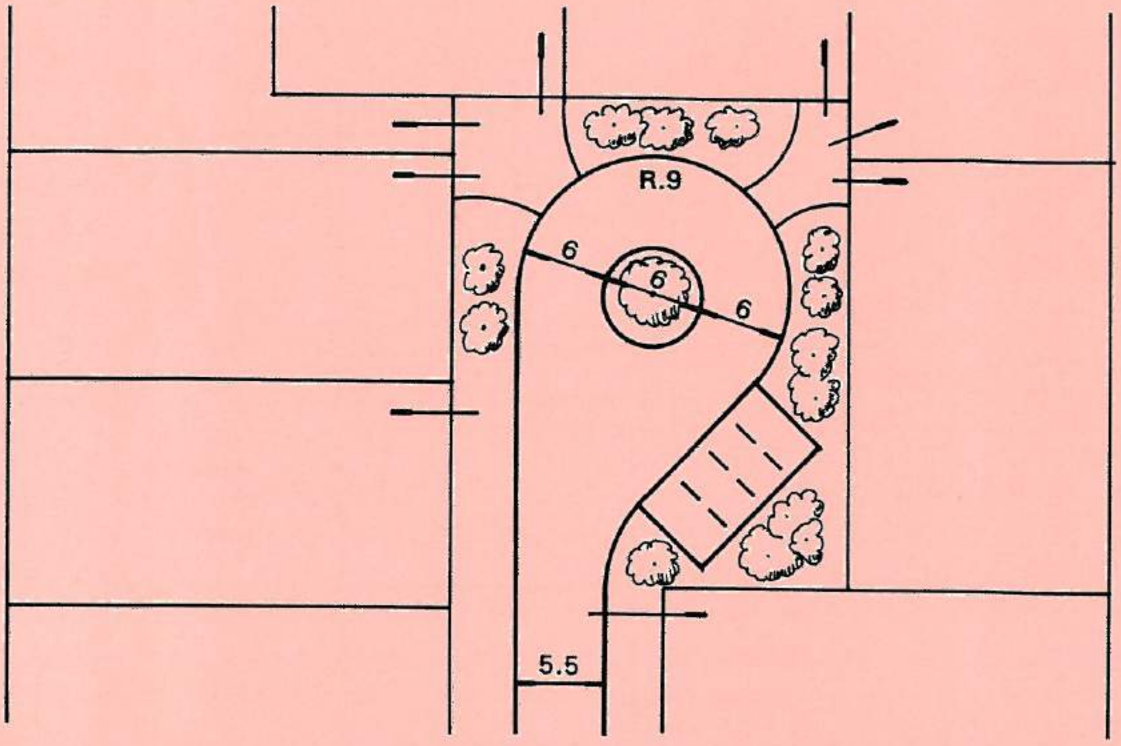
CENTRAL ISLAND WITH PARKING IN ISLAND

FIGURE. 2.12.h (a)



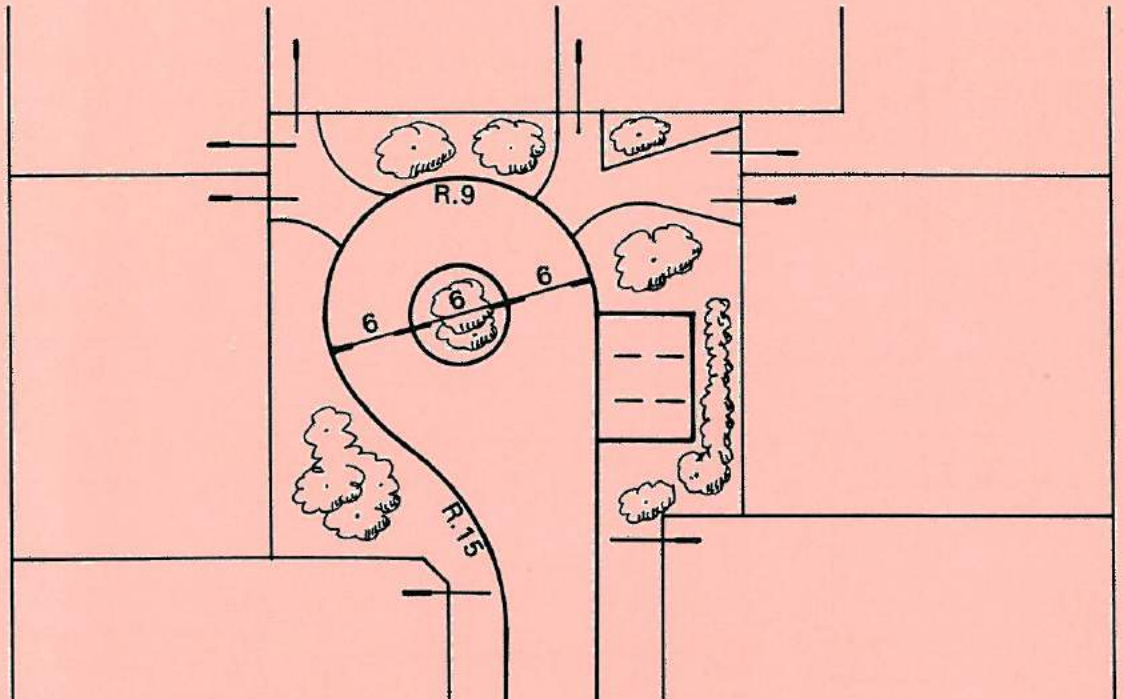
"COMBINATION" TURNING AREA

FIGURE. 2.12.J



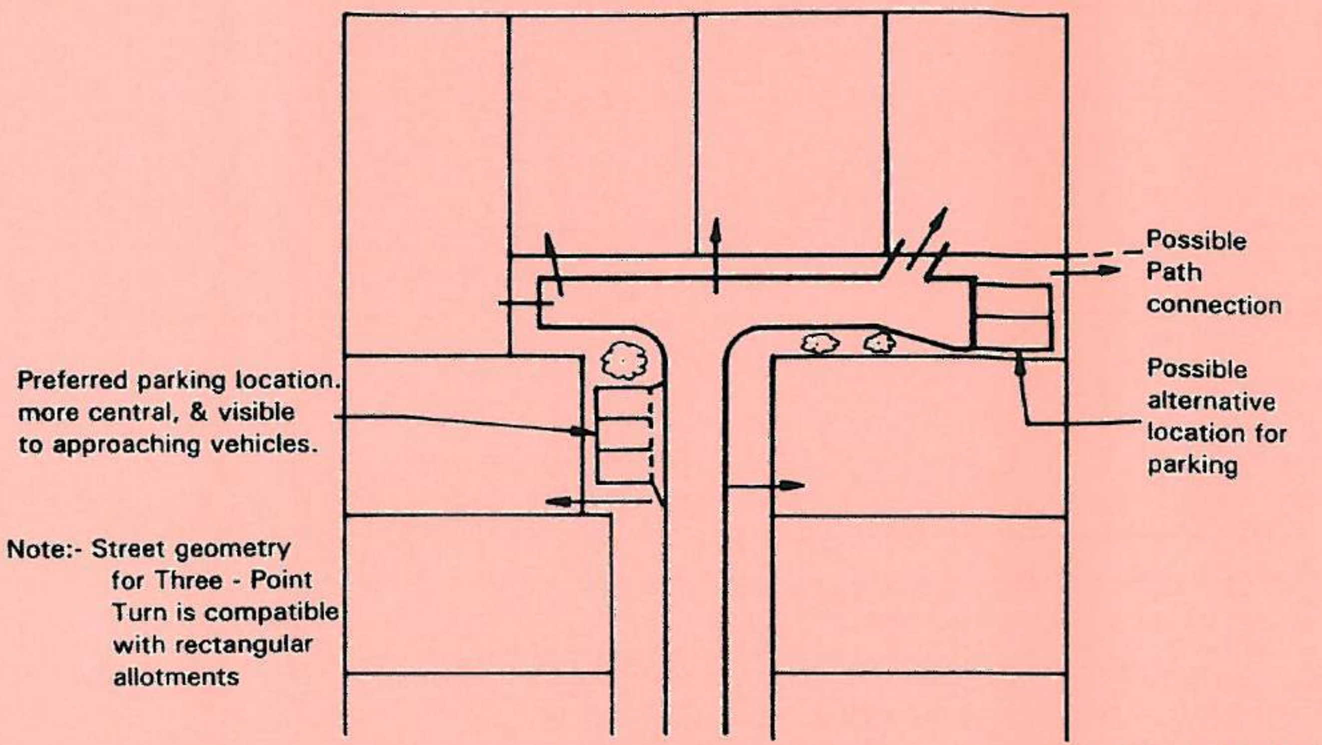
Note: Offset Heads shown in these examples, but either symetrical or offset may be used in all cases.

Carparking location may be varied to suit allotment layout.



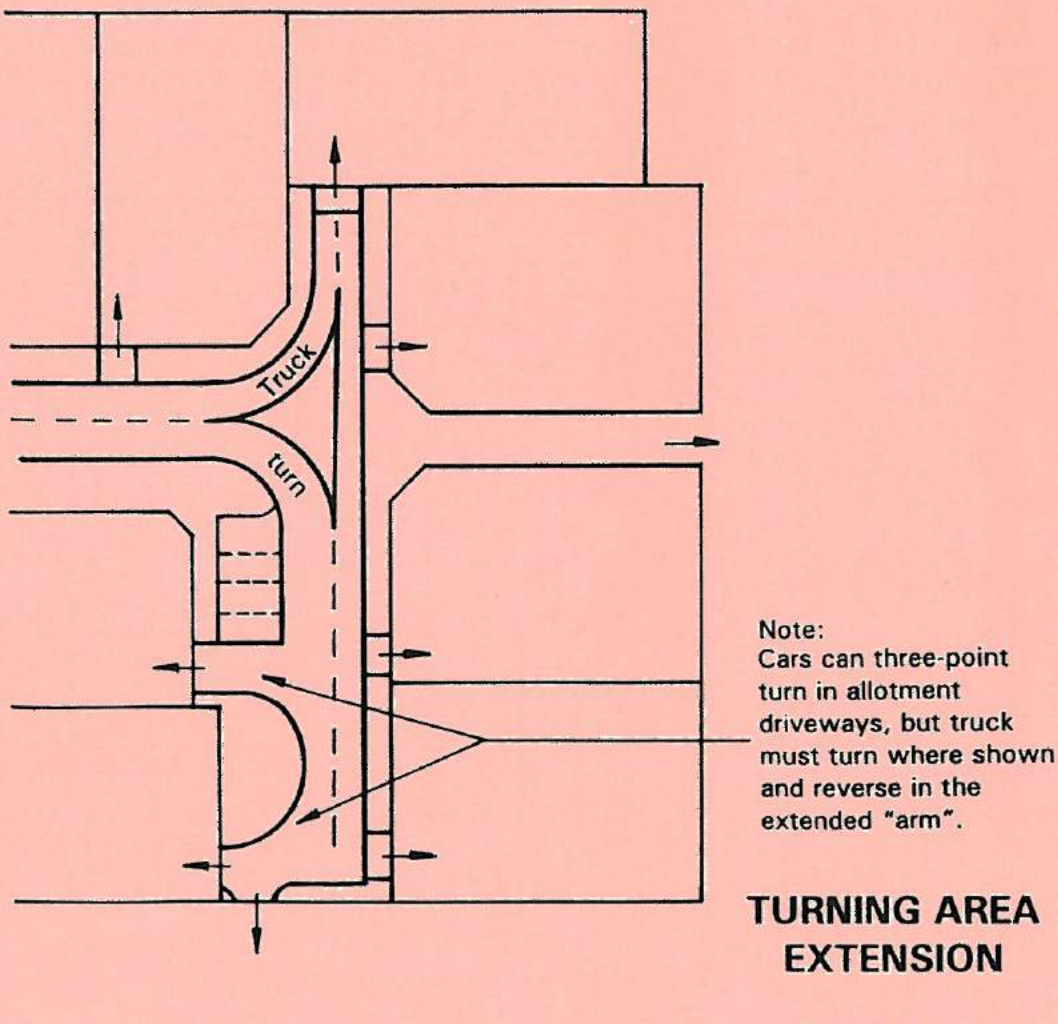
CENTRAL ISLAND WITH PARKING ADJACENT

FIGURE 2.12.H (b)



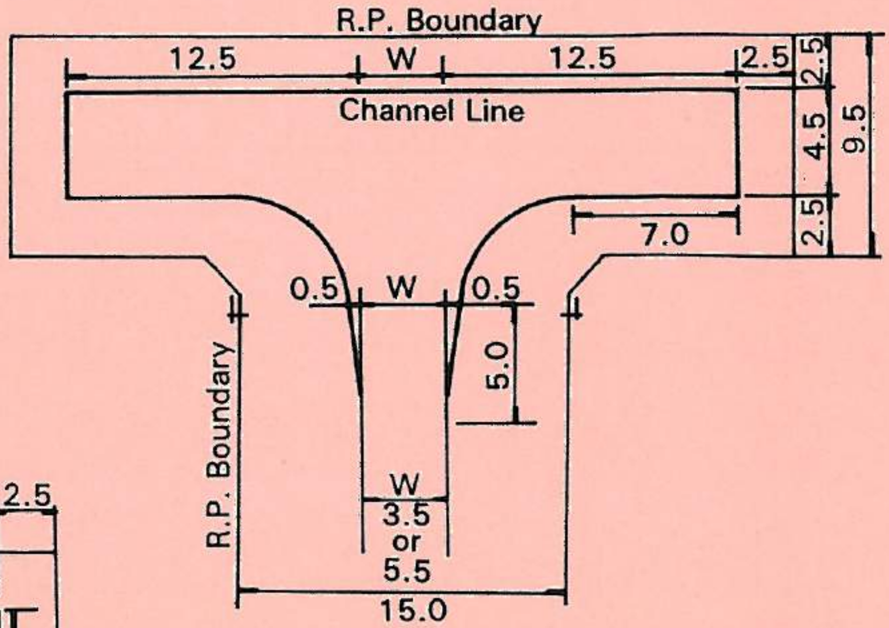
THREE- POINT TURN AND RECTANGULAR LOTS

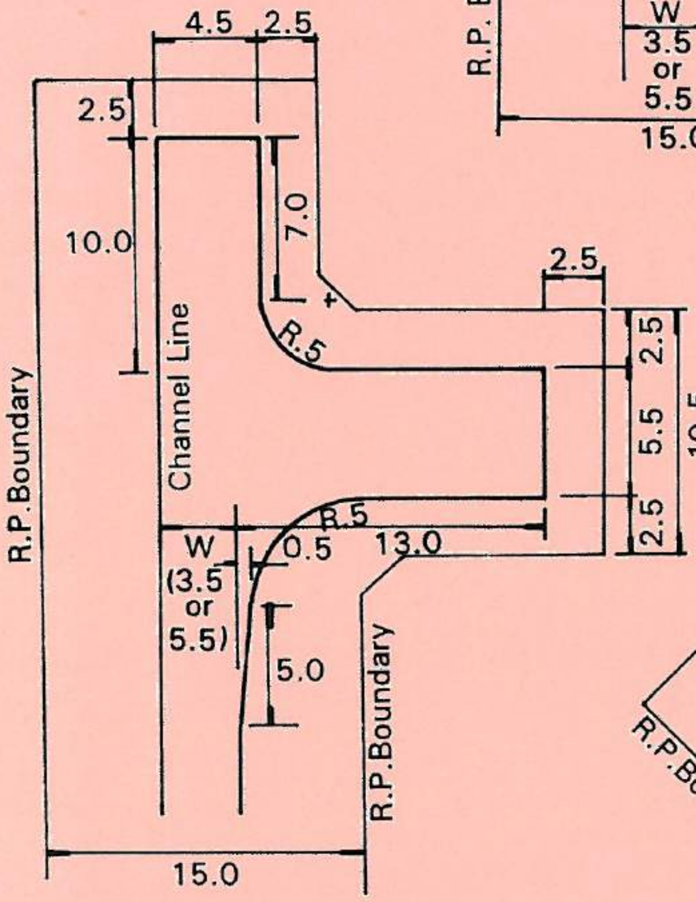
FIGURE 2.12.K



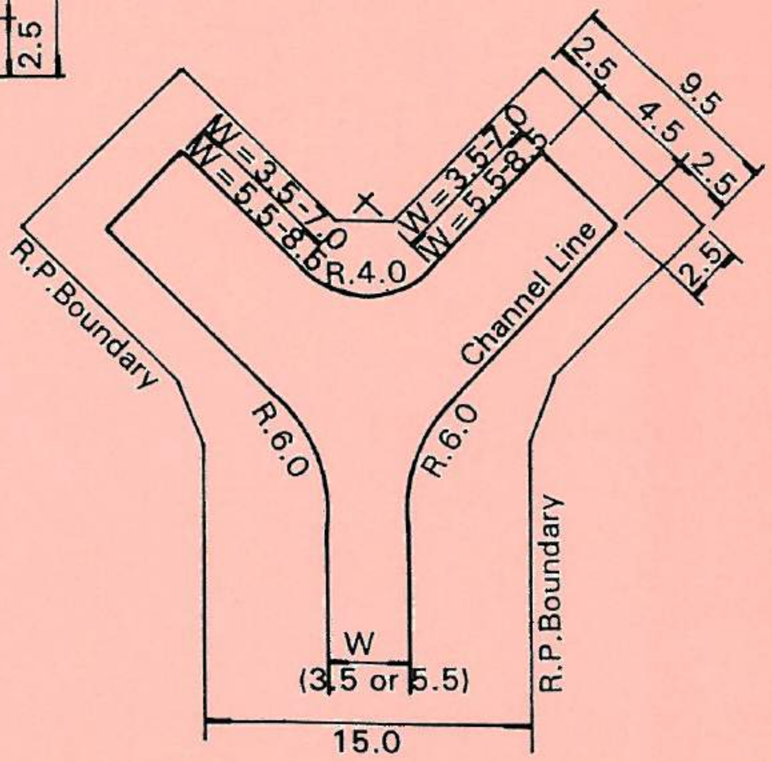
TURNING AREA EXTENSION

FIGURE 2.12.L





Note: Parking bays <u>must</u> be provided, at locations dependent on allotment layout



DESIGN CRITERIA

This turning area is based on the following:-

1. MRV type garbage truck able to turn within paved area (8.5m turn radius 4.85m wheelbase).

2. Truck able to turn any direction, to enable pick up either side, in each arm.

3. Standard HRV able to turn within street reserve by driving over kerbs where necessary.

4. Design space may be modified by adding parking bays or extending arms as access driveways.

Confirm appropriate Design Vehicle with the Local Council in every case.

TYPICAL MANOEUVRING AREAS FOR "MRV" TRUCK

FIGURE.2.12.M

SPEED CONTROL DEVICES 2.13

NEED FOR DEVICES

It is emphasised that speed control should be provided by **street alignment** wherever possible and the use of **speed control devices** should be regarded as a last resort rather than a routine measure, due both to their capital and maintenance cost, and possible intrusive nature.

DESIGN REQUIREMENTS

Speed

As noted in Commentary - 2.3, measured vehicle speeds through devices typically **exceed the generally assumed 20 km/h.** Either the geometry must be appropriately "tight" to actually achieve this speed, or Street Leg Length must be reduced to recognise the higher "end condition" speed.

Kerb Profile

In some devices, it may be appropriate to use Barrier Kerb at locations to ensure that a **heavy vehicle follows the intended path,** and **only** mounts the kerb at locations where appropriate paving is constructed.

Allotment Access

The limitation which devices may impose on access to allotments must be considered, particularly for "land only" subdivision where driveway location cannot be predicted, and with longer devices such as the "Driveway Link". Construction of the allotment driveways in these cases may be appropriate.

Drainage

Carriageway drainage may require special attention at Control Devices, particularly on very flat street grades.

Signage

The conflicting factors of minimising signage vs legal liability are mentioned in Commentary - 5.3.

Landscaping

Substantial landscaping at appropriate locations, eg close to the kerb and in Central Medians, can enhance the effective operation of devices by increasing the "visual barrier" effect.

Street Lighting

Lighting of Speed Control Devices should be provided, to the same standard as for channelised intersections.

Staged Construction

In some cases (eg integrated development) it may be appropriate to delay completion of devices until most of the housing construction is completed, to avoid damage from heavy building construction traffic.

APPROPRIATE DEVICES

The **Roundabout** and the **Central Median** are probably the most generally appropriate devices.

The **Central Median** as shown in Figure 2.13.A should desirably have a **considerably greater island width** (perhaps 4.0m minimum) to provide:-

- Effective width of landscaping, for greater visibility
- Pedestrian refuge (2m minimum, clear of heavy vehicle requirement)
- Greater deflection, for effective speed restriction

An amended "Central Median" geometry is shown in Figure 2.13.C.

Some other devices which may be appropriate in some cases are:-

- **Median Strip** (Figure 2.13.D)
  As mentioned in Commentary - Section 2.3, the provision of a Median Strip through a bend or a chicane can control the vehicle path to closely follow the carriageway centre-line radius, particularly for smaller deflection angles. Allotment access and parking may be a problem but this may be obviated by provision of an island at each end of the bend or chicane, rather than a continuous median.

- **Angled Slow Point**
  More common as a "retrofix" device, but may be appropriate for new construction. It is essentially a shorter and simpler "Driveway Link", but the length may still result in allotment access and parking difficulties.

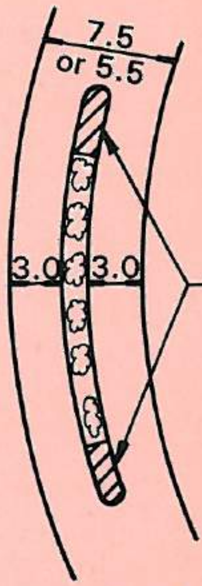
- **Deflected T Device** (Figure 2.13.E)
  Again more usual for "retrofix" situations, but may be appropriate for speed restriction on the through route of a T-junction. Maintaining clear traffic priority is necessary, typically by provision of an edge strip or changed paving across the minor leg.

REFERENCE

The publication **"Towards Traffic Calming"** issued by the Federal Office of Road Safety, Department of Transport, provides technical details and performance reviews of a large number of Speed Control Device installations.

Chicane

Note: Typical only.
Extra carriageway width and mountable islands may be required, dependent on curve radius.

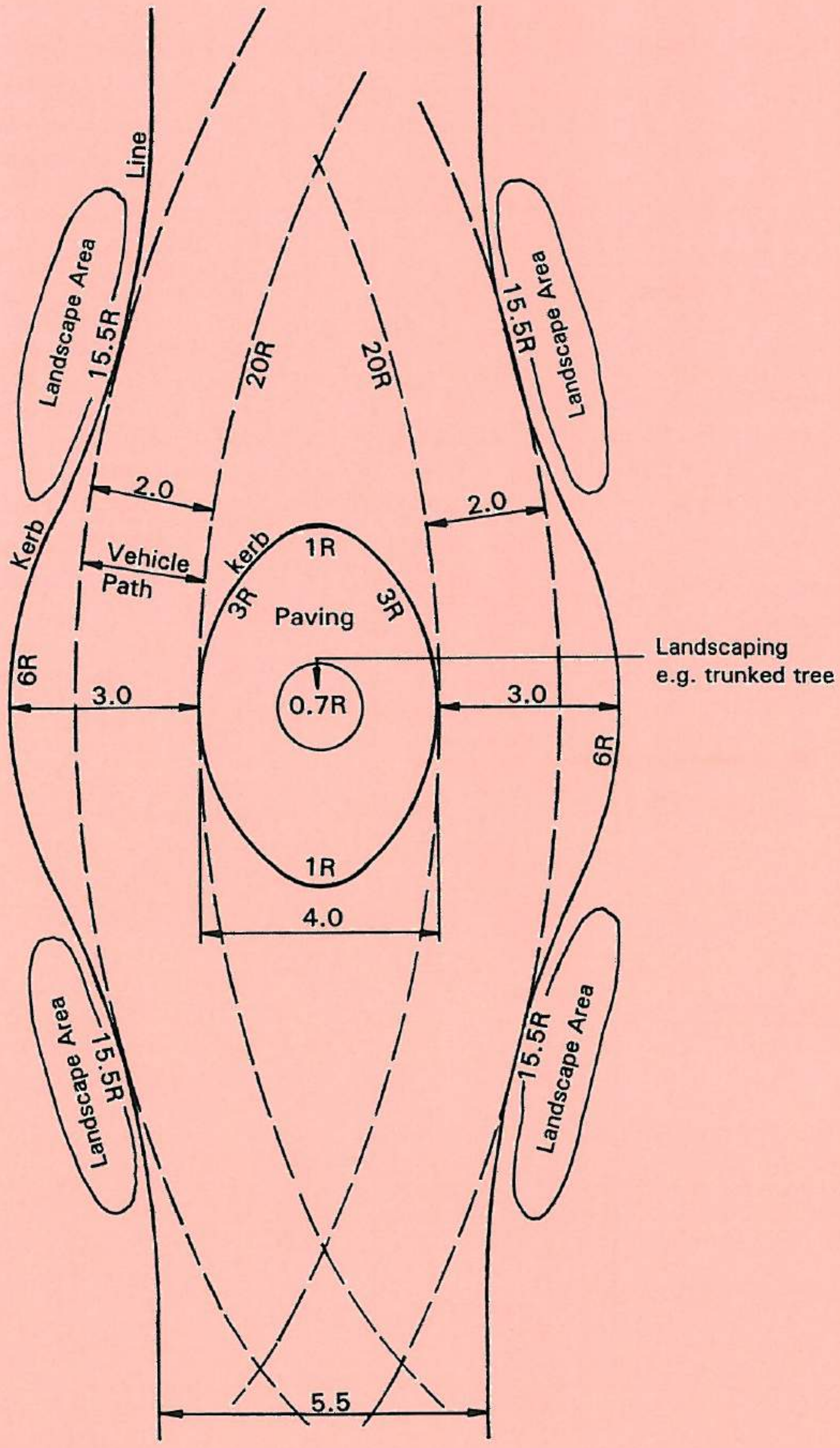


Bend

Note: For deflection angles less than 90° Median Strips or Islands can ensure that the vehicle path conforms to design radius.

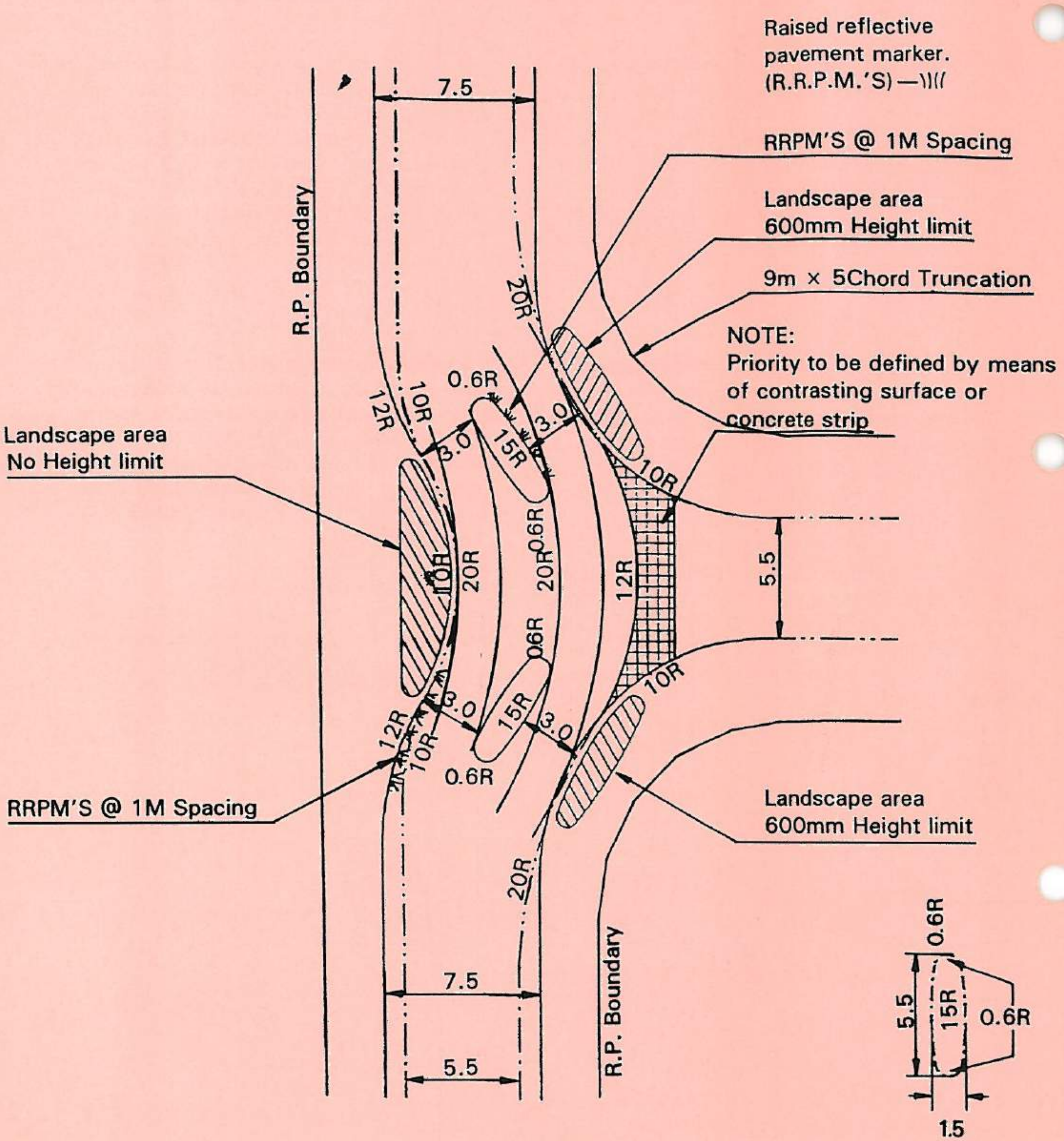
MEDIAN STRIPS

FIGURE 2.13.D



CENTRAL ISLAND
SPEED CONTROL DEVICE
(DRAFT B.C.C. STANDARD)

FIGURE.2.13.C



"DEFLECTED T"
SPEED CONTROL DEVICE
(DRAFT B.C.C. STANDARD)

FIGURE 2.13.E

3.4 PRINCIPLES OF COLLECTOR SYSTEM DESIGN

While the **form of the individual street** is determined largely by the principle of **speed limiting design**, the **layout of the subdivision** as a whole is dictated mainly by the requirements of **Traffic Volume** limitation.

As discussed in Section 3.0, the combination of design principles and economic considerations tends to result in a number of "**cells**", of maximum 300 lots, and a pronounced "**branching**" street layout in which most streets are cul-de-sacs, and with the majority of allotments accessing to quite **short cul-de-sacs**.

While this form of subdivision has been criticised in some quarters (see Commentary 1.8), it is considered that this "fully branching, hierarchical" street system is appropriate for Residential streets, being superior in **Safety, Amenity and Economy** to the alternative "Grid-iron" street pattern. However care is needed in design to minimise the potential for reduced **Convenience**.

Essentially:

- **Internal Connectivity** within the neighbourhood should be provided such that all residents can readily access community facilities, schools, shops, transit facilities, etc without the need to use the external Major Road system. This will enhance the sense of "Community" and integration of the neighbourhood.

- **External Connections** to the Major Road system should be located with consideration to the external traffic attractions, to minimise total travel times, but without creating potential traffic routes through the neighbourhood.

- **Pedestrian and Cyclist** connectivity of a high order is essential, and can be readily provided by strategically located pathway and park links between streets.

- **Legibility** of street layout as recommended in the Guidelines should be considered, and augmented if necessary by detailed intersection design (See Commentary 2.11).

- **Bus Routes** should be considered, in accordance with the recommendations of Section 3.5 and Commentary.

In practice, the major conflict that arises is between the principles of "**Connectivity**" and "**Impermeability**". Connection between streets in the same "cell", eg connecting the heads of streets that would otherwise be cul-de-sacs to form a "loop" system, is unlikely to be a potential problem, but connections between "cells", and to the external road system, must always be checked against their potential to create unintended **through traffic routes.**

Provided that **Internal Connectivity,** and **External Connections** are provided as above, there should be no need for additional inter-connection for convenience.

However, if it is considered that street connections may be required in the future, eg for possible changes of land use adjacent to a "Central Core", an option could be to **dedicate but not construct** the street connections. In the interim these reserves can serve as Open Space areas, pedestrian / cycle path links, service routes, and possibly emergency vehicular connections.

3.5 BUS ROUTES

Encouragement of the use of public transport rather than private cars is a worthy Planning objective, and the Guidelines endorse the ideal that 90% of allotments be located within 400m of a potential bus route.

However in most cases this ideal is likely to require part at least of the potential bus route being located on Collector Streets. This can pose problems, as ideal Collector Street layout and geometry may not be compatible with bus operating requirements, in that:-

- **Lack of connectivity** in the Collector Street system, necessary to ensure impermeability to through traffic, is likely to necessitate a "loop" type bus route.
- **Geometry of speed control devices** capable of restricting car speeds will generally necessitate vertical displacement of a bus, with consequent discomfort and possible danger to passengers.

Possible compromises include:-

- Less than ideal provision of potential bus routes
- Less than ideal Collector Street layout and/or geometry
- Speed restrictive design on Collector street bus routes by alignment only, with no Speed Control Device.
- Provision of some additional Trunk Collector Streets, to satisfy bus route requirements
- Use of mini-bus services in Residential areas, feeding to "Line-Haul" services on the Major road system.

The appropriate decision may rest on a realistic assessment of whether the bus route is "probable" rather than just "potential" in the light of local circumstances, which highlights the need for a Local Authority **Transport Strategy Plan** for the area.

3.7 THE "NO-ACCESS STREET" (TRUNK COLLECTOR)

ECONOMY

Initially, there was concern that the "No-Access" street could be an unacceptable burden on development. However, practical experience has shown that the need for these streets can be eliminated, or at least minimised, in all but very large developments.

For example, a very short length of Trunk Collector may provide access for perhaps 900 allotments, and may also provide access to a local shopping centre and/or multi-unit residential (Figure 3.7.B).

In some cases, where there is multiple ownership of smaller development parcels accessing via a Trunk Collector street, it may be necessary for the Local Authority to finance its construction by a "**Headworks**" type contribution.

STANDARDS

Type cross-sections for the Trunk Collector are referenced in the Guidelines as Figure 3.7.A, but this figure was actually printed on page 97, as the Sub-Arterial Road sections.

However, since the economic impact of the Trunk Collector is not as significant as originally envisaged, a slight increase in carriageway width is recommended, to provide additional stormwater capacity with kerb and channel, and less edge maintenance and provision for breakdown parking, with swale drainage.

Amended **recommended cross-sections** are shown in Figure 3.7.C.

For a **short street** such as shown in Figure 3.7.B, the **divided carriageway** option (2 x 5.0m) may be appropriate, as the median landscaping possibilities can provide an "Entry Statement" into the development.

The divided road configuration also blends with channelisation at the intersections each end, and at any intermediate access points, and provides improved pedestrian crossing safety. However, for **longer** Trunk Collectors the **single carriageway** will probably be dictated by economy.

Kerb and channel will generally be appropriate for short street lengths and/or frequent intersections, with **swale drainage** an option for longer street lengths.

DRAINAGE

An appropriate stormwater flow width limitation for minor storms could be **2.0m** maximum from the channel, retaining a single lane, or two restricted width lanes (2.5m each), clear of water on the single carriageway, and a 3.0m lane clear on each divided carriageway.

Compliance with this limitation may require special design measures, such as widening and steepening the paved "shoulder", providing extra or special inlets, or using the swale drain option.

ACCESS RESTRICTION

Practical restriction of access to Trunk Collectors, from the side or rear of abutting residential lots, may require legal means such as Access Limitation Strips, and/or physical means such as mounding or fencing.

SOUND ATTENUATION

On Trunk Collectors with higher traffic volumes it is probable that sound attenuation measures such as mounding, planting and/or fencing will be required between the street and adjacent lots, as the set-back distances required for attenuation become excessive without such additional measures.

As an indication only, appropriate distances from kerb to house site without other measures would be:-

4000 vpd	16 m
5000 vpd	19 m
6000 vpd	23 m
7000 vpd	27 m

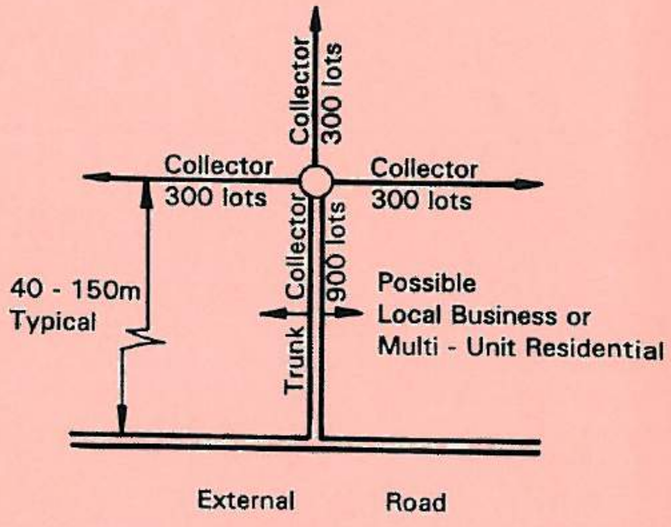
Based on AMCORD Background Data: Pak-Poy & Kneebone Pty Ltd 1989.

3.9 LEGIBILITY

There may be a temptation to utilise 'T' intersections to introduce 90° bends into a 'through' street such as a Collector. However this may result in a confusing street layout ("illegible"), and ambiguous traffic priority at the intersections. As a general principle, the major route should be the 'through' street and have traffic priority (Figure 3.9.D).

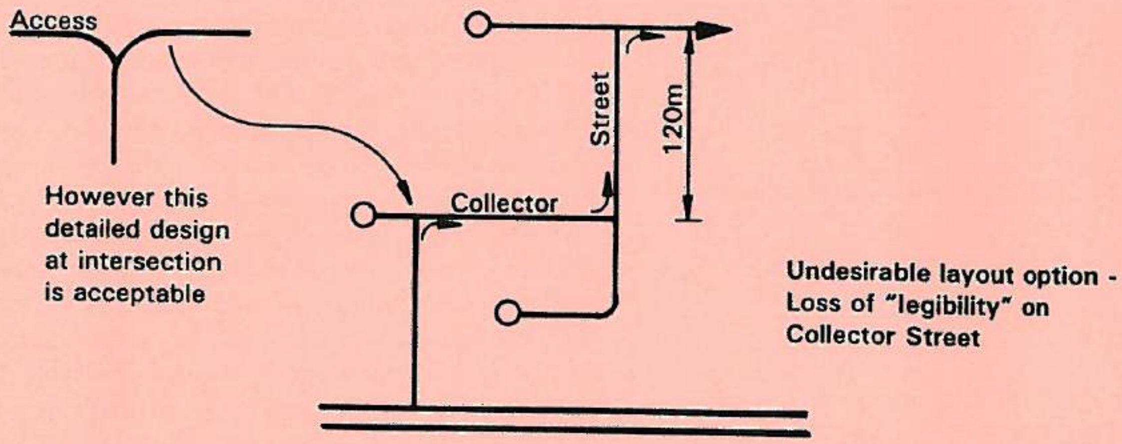
In such cases the necessary bends should be separate from intersections, or the detailed geometry of the intersections should be such that the major route is the "through street" and has priority. In the case of a Roundabout however, the major route should desirably be "straight through", rather than at 90°, due to the difficulty of establishing the relative importance of the streets by geometry.

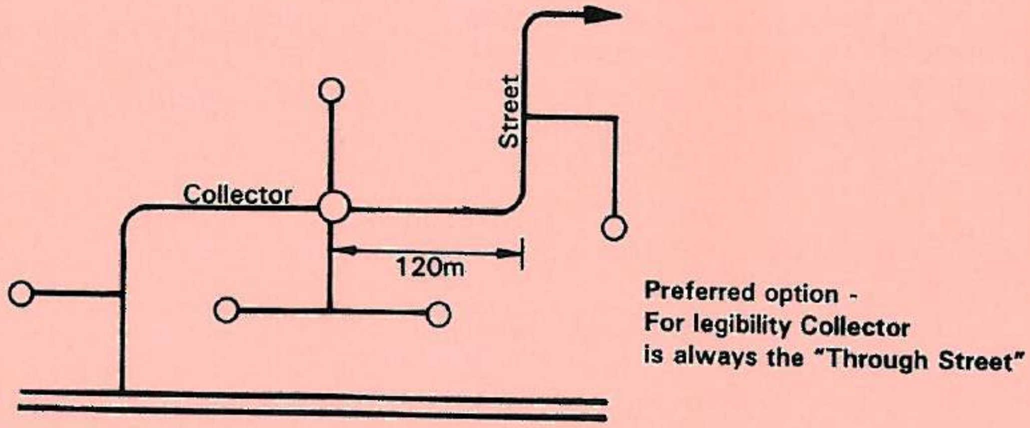
Where the streets are of equal importance, eg two Access Streets, the 'T' intersection may reasonably be used to limit street leg length.



POSSIBLE TRUNK COLLECTOR LAYOUT

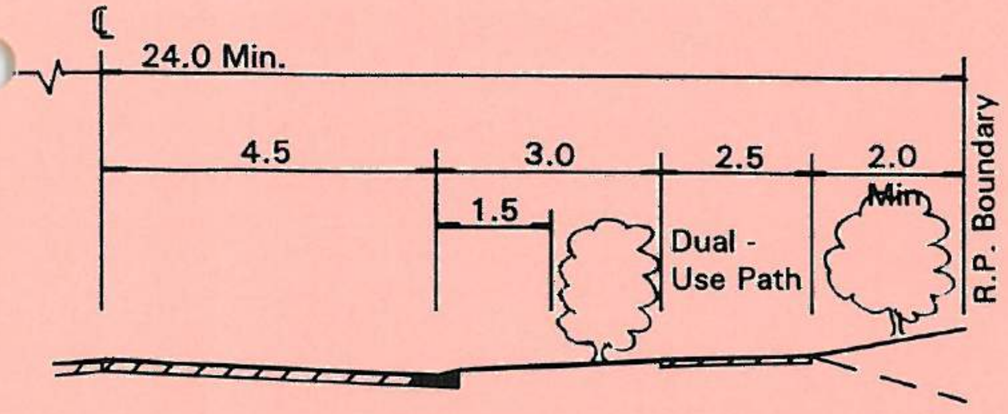
FIGURE. 3.7.B





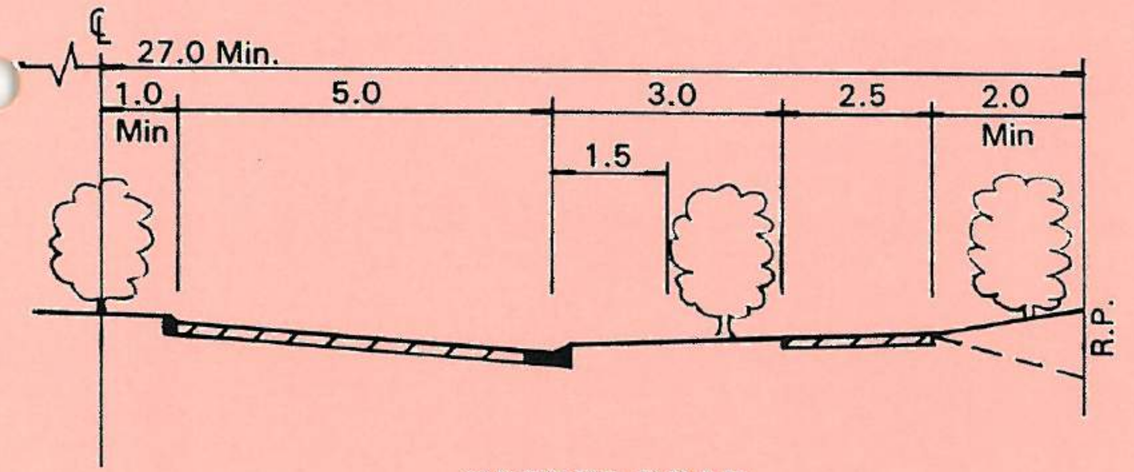
COLLECTOR STREET LAYOUT - 90° BENDS

FIGURE. 3.9.D

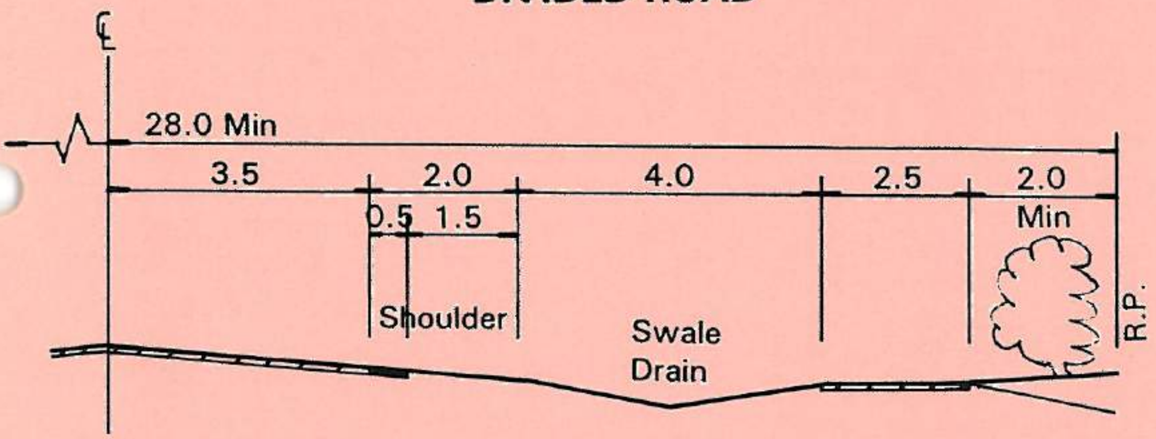


Note: Where provision for pathways is not required:
Verge Width - 4.5m. Min
Reserve Width - 20m. Av

WITH KERB & CHANNEL



DIVIDED ROAD



WITH SWALE DRAIN

TRUNK COLLECTOR STREET
TYPICAL CROSS - SECTIONS

FIGURE. 3.7.C.

4.2 PLANNING

ROUTE LOCATION

In the case of **Cycle Routes**, a distinction is necessary between **Recreation Routes** where cyclists will accept a lower speed design and more meandering location, and **Commuter Routes** where cyclists will use the Major Road system unless the cycle route provides comparable design standards.

SYSTEM COMPONENTS

Cycle Lanes

Designated cycle lanes within the carriageway of Major Roads are a possible option for providing for cyclists within the existing road system, and there is a current trend towards their use, particularly on identified **Commuter Routes**.

However, within new Residential Development separate **Cycle paths or Dual-Use Paths** will generally be the preferable option.

4.3 RESIDENTIAL PRECINCTS

PARTICULAR CASES CROSSING POINTS

Combined Slow Points
It is generally considered that pedestrian / cycle crossing points **may** be combined with a designed Speed Control Device subject to appropriate design.

For example, a **Central Median** speed control device may also provide a central refuge island for pedestrians and cyclists. However sufficient refuge width (eg 2.0m for pedestrians or 3.0m for cyclists) must be available **in addition** to the width which may be traversed by heavy vehicles, and appropriate ramps should be provided.

A Raised Threshold may also double as a pedestrian / cycle crossing.

Physical Barriers
Barriers to prevent pedestrians and cyclists from directly crossing the street must be designed to fulfil this function both effectively and safely. A minimum height of 1.0m will normally be appropriate.

Crossing Priority
While crossing points at appropriate locations may be specifically **designed**, eg with refuges, barriers etc, it is emphasised that "Pedestrian Priority" crossings (ie "Zebra" crossings) are **not** advocated, as it is considered that such crossings give pedestrians a potentially dangerous false sense of security.

Where traffic volume and speed is such that pedestrians can no longer cross with acceptable safety and convenience, a **signalised crossing** should be provided. This will not normally occur on streets / roads below the Sub-Arterial road.

4.4 MAJOR ROAD SYSTEM

DUAL-USE PATHS

The necessity for recognition of **Dual-Use Paths** as a fact of life has been emphasised by the failure of design attempts to segregate pedestrians and cyclists by means such as separate parallel paths, central kerb, or different materials (eg concrete and bitumen). In real life, each type of traffic uses either path.

The possible exception is where the volume of cyclists on a cycle path is sufficiently high to present an obvious danger to pedestrians (eg Coronation Drive, Brisbane).

Note that the current recommended width for a Dual-Use Path is **2.5m**, rather than 2.0m as quoted in the Guidelines.

4.5 SEPARATE RESERVES

PATHWAYS

The desirability of pedestrian / cyclist pathway connections, eg between the heads of cul-de-sacs, to **maximise connectivity** for pedestrians and cyclists, and provide routes away from the Major Road system, cannot be over-emphasised (see Commentary Sections 1.8 and 3.4).

4.7 DESIGN STANDARDS

Appropriate technical details for Cycle Paths are provided in "Bicycles, Guide to Traffic Engineering Practice" (AUSTROADS, 1993).

5.1 KERB AND CHANNEL

RECOMMENDED PROFILES

The majority of Local Government engineers appear to favour a **Driveover Kerb** profile which is **easier for vehicles to negotiate** than the LGEA R-01 standard recommended in the Guidelines. That this feeling is shared by many vehicle owners is evidenced by the widespread use of illegal timber, concrete or steel devices to ease the crossing of the kerb and channel by vehicles.

However, ease of crossing must be balanced against the drainage function of the kerb and channel. Reducing the height of the kerb will considerably reduce the available waterway within the carriageway. Overtopping of the kerb is however recognised by QUDM as being an acceptable situation in a Major Storm, and need not necessarily be a problem in a Minor Storm **provided that:**

- **Properties below the street** are protected by the verge cross-section providing an appropriate freeboard (50mm above the Major Storm level, or 215mm above the channel lip is QUDM current requirement).
- **Pedestrian Footpath** is clear of Minor Storm level.

The current **Verge Profile** (Figure 2.8.G) fulfils both these requirements, provided that the minimum verge height relative to the channel lip is not reduced below the present 215mm.

More difficult to compromise against a reduced kerb height may be **gully pit** design, as maintaining an acceptable height of kerb inlet opening may require either raising the inlet lintel above kerb level (unaesthetic) and/or increasing the channel depression (unaesthetic, and possibly a hazard to cyclists and pedestrians).

Standard **Kerb Profile** and **Gully Pits** will be considered in the Institute's current "Standard Drawings and Specifications" project.

5.2 UTILITY SERVICES

The more "free-form" street designs encouraged by the guidelines have a significant effect on service locations, as not only may carriageway alignments be quite sharply curved, but road reserve boundaries may vary in alignment and even be "stepped" in places.

Sewers and stormwater drainlines, which must be straight between manholes, must necessarily cut across the verge and / or the carriageway in places, unless an unreasonable number of manholes are provided. Other services may not always be able to follow abrupt steps in the reserve boundary. The result is that it may not always be practicable to have service allocations in a constant location, and a more **flexible approach** may be required by all service authorities.

One alternative suggested is that service allocations be based on the **kerb line** rather than the reserve boundary, on the basis that while both are variable, the kerb line varies with curves which the relatively small-sized services in Residential streets can follow, whereas the reserve boundary may have 90° steps.

Landscaping over services is a further issue. Generally the most appropriate place within the street for landscaping, such as mounding and heavy planting, is adjacent to the property boundary, but this is also the typical location of services. If future access to services under landscaping is seen as a problem by the service authorities compromises may be possible, such as placing the service in a conduit under landscaping features, or installing house connections (eg water services) at the time of street construction, to avoid later excavation.

In practice, it is necessary that the Street Designer have the onus of selecting appropriate alignments for all services, and negotiating to secure the agreement of all relevant service authorities before submitting the design for Local Government approval.

5.2 STORMWATER DRAINAGE

By comparison with "conventional" streets, the narrower carriageways and street reserves recommended by the Guidelines inevitably reduce the available waterway for overland stormwater flow. This must be taken into account in the **strategic design** of the stormwater system early in the subdivision design process, probably most appropriately by providing more frequent outlets from the street system via pathways or park strips.

Aspects of detailed stormwater design affected by the street cross-section are referenced in the Commentaries on sections:

- 2.10 Carriageway Cross-Section;
- 3.7 Trunk Collector Streets;
- 5.1 Kerb and Channel
- 6.4 Sub-Arterial Roads.

5.3 SIGNS AND PAVEMENT MARKINGS

As set out in the Guidelines, the principle of **designing** correct operation into the street system, and keeping the use of signs and marking to a minimum, is certainly the ideal. However, many Local Government engineers have understandable concern as to the Public Risk liability implications of this situation.

The current edition of the "Manual of Uniform Traffic Control Devices" (MUTCD), Part 13, Section 3 sets out criteria for the omission of a considerable number of signs and markings at typical speed control devices, provided that (in summary):

- Devices are within an area-wide scheme;
- Perimeter treatments are provided at all entrances to the area;
- Internal treatments are at recommended maximum spacings;
- An area-wide speed limit is imposed.

While MUTCD provides an authoritative basis for minimising signage and markings, the Institute is making further representations on this matter.

INTRODUCTION

This Section of the Guidelines is included principally to place the **Street System** in context with the **Road System**, particularly in regard to the constraints of access and connection which the requirements of the Road System impose. Hence it provides only an overview of Major Road characteristics.

However the **Sub-Arterial Road** is discussed in some detail, as this category of road is relatively unknown in traditional Street / Road hierarchy, and unlike the other road classes its location is largely dependent on the residential development.

6.4 SUB-ARTERIAL ROADS

CHARACTERISTICS

The similarity in **form** between the Sub-Arterial Road and the **Trunk Collector Street** is obvious - both have very similar cross-section, two moving lanes, no provision for parking, and no frontage access.

The major difference is in **location**:-

- **The Trunk Collector Street** is **within** a residential neighbourhood, and hence is designed with speed-restrictive techniques and will typically have kerb and channel as for other streets.
- **The Sub-Arterial Road** is a **boundary between** neighbourhoods, and typically connects at each end to other Roads. Hence it is designed with conventional **minimum** speed technique, and may **not** be kerbed.

The Sub-Arterial Road and the Trunk Collector Street together are the replacement for the old functionally ambiguous **Collector**, which typically had two moving lanes, two parking lanes, and direct property access.

STANDARDS

The **Type Cross-Sections** shown in the guidelines for the Sub-Arterial Road (page 97) were actually those intended for the Trunk Collector Street.

For the greater traffic significance of the Sub-Arterial Road, and slightly higher traffic volume and speed, a more liberal cross-section is considered appropriate, such as shown in Figure 6.4.E.

Generally the **Swale Drain** alternative will be preferable, as it:-

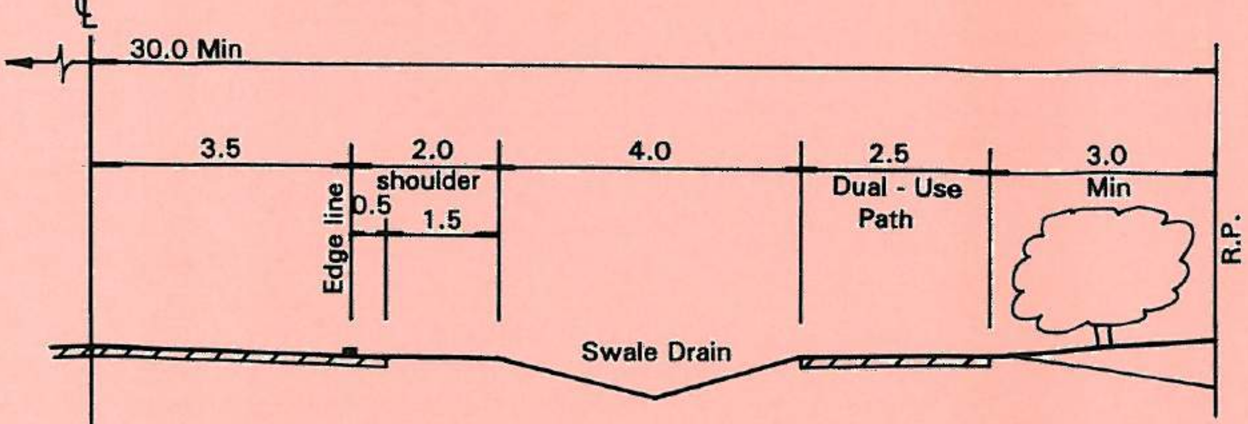
- Typifies the "Traffic Route" status of the road (no kerbing)
- Facilitates emergency parking of a disabled vehicle
- Minimises risk of stormwater pondage in traffic lanes.

For the **Kerb and Channel** section, appropriate stormwater flow width criteria for a minor storm could be **2.5m maximum** from the channel, thereby maintaining two 3.0m lanes clear of water. This may require special design measures such as widening the sealed shoulder, steepening the shoulder crossfall, and / or extra inlets.

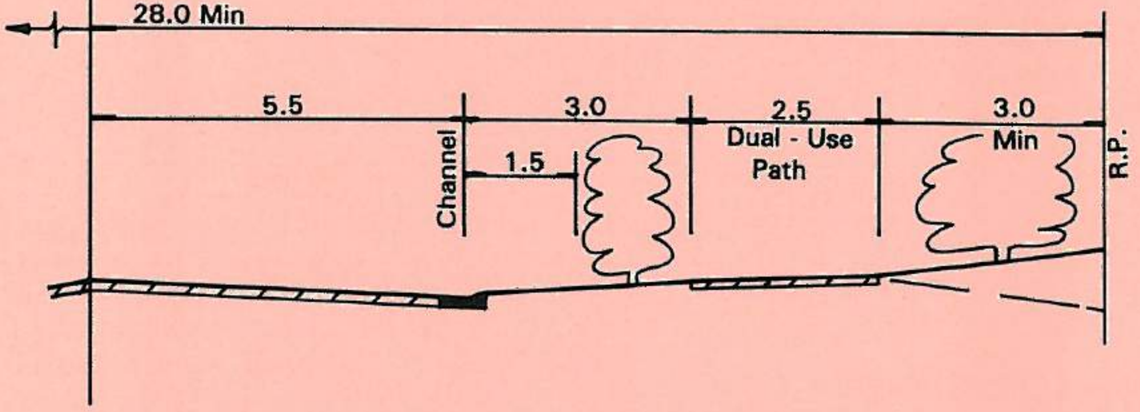
ACCESS RESTRICTION AND SOUND ATTENUATION

Measures for restricting access and attenuating traffic noise will be required between the road and any adjacent residential lots, as discussed for Trunk Collector Streets.

For Sub-Arterial Roads, with a higher traffic volume and slightly higher travel speed, these measures are even more significant.



WITH SWALE DRAIN



WITH KERB & CHANNEL

SUB - ARTERIAL ROAD TYPICAL CROSS - SECTIONS

FIGURE. 6.4.E