DEVELOPMENT CODE

June 2009
Updated January 2010

PAPAKURA DISTRICT COUNCIL

DEVELOPMENT CODE

JUNE 2009

PART 3: ROADS

3.1 SCOPE

This part of the code of practice sets out requirements for the design and construction of roads associated with land development and improvement projects within the District.

3.2 GENERAL

Road design guidelines set out herein cannot be expressed entirely in performance terms nor can any single set of design standards be suitable for all local conditions. This code is not intended to be a comprehensive design guide but focuses on a number of considerations which are regarded as significant factors in the design process.

Sections 3.1 and 3.2 apply to all roads in the Papakura District.

Road layouts shall comply with the relevant rules in the District Plan.

All roadwork should be in accordance with NZS/AS1428.4 "Design for Access and Mobility" and RTS 14 “Guidelines for Installing Pedestrian Facilities for People with Visual Impairment".

3.2.1 The Road Pattern and Hierarchy

For matters pertaining to road layout refer to Part 9 of Section 3 of the District Plan and Table 3.1 herein.

The road network is categorised by a hierarchy of roads which serve a variety of purposes and have differing requirements with respect to access and maintenance levels. Within the district the following roads and their functions have been classified in the District Plan as follows:

- Primary Arterials which provide for the through movement of traffic.
- Principal Roads (secondary arterials) which provide for the through movement of traffic.
- Local Roads which provide for property access and traffic, collection and distribution.

In this code of practice all roads within the district shall be referred to as they are more commonly known in other cities and districts, namely:

- Arterial Roads – includes both the Primary Arterials and the Principal (Secondary Arterials mentioned above).
- Collector Roads – Generally local high volume roads with general purpose of feeding traffic from residential zones to arterial roads.
- Local Roads – All other roads including residential streets and low volume rural roads.

The RAMM Inventory (Council’s inventory of roads) should be consulted if there is doubt as to the status of any particular road.

3.2.2 Parking

For matters pertaining to parking refer to Table 3.1 and 3.2 herein, and Part 15 of Section 3 of the District Plan.

Provision shall be made for the parking of vehicles on all roads. Alternative widths and layouts may be suitable which provide for parking in defined areas clear of the through traffic.

Carriageway Parking
As the traffic function of a road becomes more important, it is necessary to provide more specifically for vehicle parking so that moving traffic is not impeded.
On industrial roads, because of the mixing of light vehicles with long, less manoeuvrable, heavy vehicles, parking width shall be provided on each side of the carriageway to leave a clear line for moving traffic only.

Indented Parking
To facilitate a clear traffic pathway, indented parking bays and parking in the middle of cul-de-sac heads may be considered.

Mobility Parking
Mobility parking spaces shall be designed according to NZS 4121 Design for Access and Mobility – Buildings and Associated Facilities.

Unless modified in this code all parking shall be designed in accordance with Austroads Guide to Traffic Engineering Practice Part II – Parking.

3.2.3 Carriageway, Road and Formation Widths

For matters pertaining to carriageway, road and formation widths refer to Table 3.1 herein, and the Papakura District Council Standard Cross Section Plan.

The Papakura District Councils District Plan provides alternative solutions and design concepts where Council may accept alternative designs where they support integrated traffic with a focus on walking and cycling.

TABLE 3.1: MINIMUM ROAD PROFILE

Indicative Traffic Volume (1)	Carriageway Width m (exclusive of parking)	Parking Provisions Within Road Urban Only (4)	Kerbing			Footpath Provision			Cycle path Provision (2)	Berm Width (Each Side) (6)
			Urban	Countryside Living (Town)	Countryside Living (Rural)	Urban	Countryside Living (Town) (5)	Countryside Living (Rural) (5)		
Up to 300 veh/d	6.0 m(7)	0.75m hardstanding berm space per site	Mountable/ upright with drainage channel (3)	Mountable/ upright with drainage channel	Open water table refer detail A standard detail R28	1.5 m wide footpath (one side)	1.5 m wide footpath (one side)	Not required	Not required	4.5 m minimum
300 to 1,000 veh/d	6.0 m (7)	1.0m hardstanding berm space per site	Mountable / upright with drainage channel (3)	Mountable/ upright with drainage channel	Open water table refer detail A standard detail R28	1.5 m wide footpath (both sides)	1.5 m wide footpath (one side)	Not required	Not required	6.0 m minimum
1,000 to 3,000 veh/d	6.5 m (7)	1.0m hardstanding berm space per site	Mountable / upright with drainage channel (3)	Mountable/ upright with drainage channel	Open water table refer detail A standard detail R28	1.5 m wide footpath (both sides)	1.5 m wide footpath (one side)	1.5 m wide footpath (one side)	Not required	6.0 m minimum
More than 3,000 veh/d (with access to residential lots) (Collector Road)	7.0 m (7)	1.0m hardstanding berm space per site	Upright with drainage channel (3)	Mountable/ upright with drainage channel	Open water table refer detail A standard detail R28	1.5 m wide footpath (both sides)	1.5 m wide footpath (one side)	1.5 m wide footpath (one side)	If required by an approved cycleway plan 3.0 m cycle path one side only in the berm or two 1.5 m wide cycle lanes marked on the carriageway	7.0 m minimum
3,000-7,000 veh/d (Arterial Road)	Dual carriageway (2 x 5 m minimum) plus median. Indented bus bays on bus route	If required parking to be provided in areas/locations which can be exited in a forward direction and includes parallel parking	Upright with drainage channel (3)	Mountable/ upright with drainage channel	Open water table refer detail A standard detail R28	1.5 m wide footpath (both sides)	1.5 m wide footpath (one side)	1.5 m wide footpath (one side)	3.0 m cycle path one side only in the berm or two 1.5 m cycle lanes marked on the carriageway	7.0 m minimum
Over 7,000 veh/d	Subject to specific design	Subject to specific design	Subject to specific design (3)	Subject to specific design	Subject to specific design	Subject to specific design	Subject to specific design	Subject to specific design	Subject to specific design	7.0m

Footnotes:

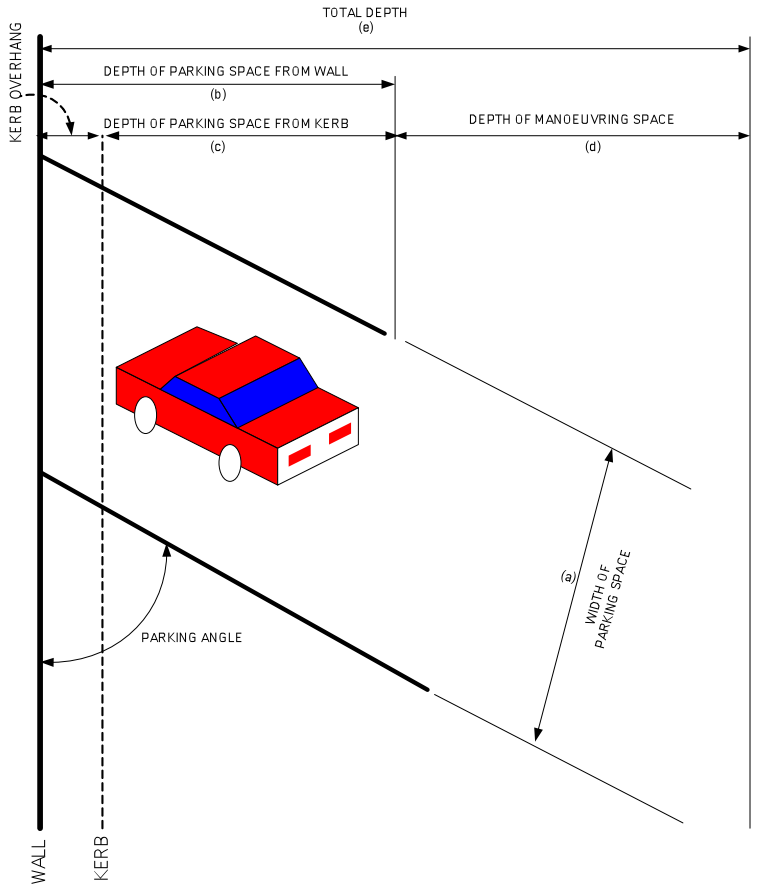
(1) Indicative traffic volumes includes all potential future traffic generated from the catchment accessed by the road (assessed at 10 v.p.d./dwelling unit).
(2) Where cycle use can be anticipated, an uninterrupted cycle path of 1.5 m in width is required along the kerb (to be delineated by a 150 mm wide white line).
(3) Compliance with Section 331(2) of the Local Government Act 1974 making provision for disabled persons is required.
(4) For dimensions of parking spaces, refer to Table 3.2.
(5) Footpath is to be a minimum of 2.5 m from the kerb.
(6) Berm width includes footpath and off carriageway parking provision.
(7) For all urban through roads minimum carriageway width shall increase by 2 metres, which may satisfy the parking requirements.

Legend
1. Numbers in brackets refer to the footnotes below.
2. . All dimensions are in metres.

TABLE 3.2: PARKING SPACE DIMENSIONS

Type of Parking		Stall Width (a)	Stall Depth		Manoeuvre Aisle Width (d)	Total Depth (e)
Parking Angle	Type		From Wall (b)	From Kerb (c)		
		ALL MEASUREMENTS ARE IN METRES				
90°	Nose in: left turn	2.5 2.6 2.8	4.9	3.9	7.7 7.0 6.6	12.6 11.9 11.5
90°	Nose in: right turn	2.5 2.6 2.8	4.9	3.9	8.4 7.9 7.5	13.3 12.8 12.4
75°	Nose in	2.5 2.6 2.8	5.2	4.2	6.3 5.2 4.1	11.5 10.4 9.3
60°	Nose in	2.5 2.6 2.8	5.2	4.2	4.1 3.5 3.2	9.3 8.7 8.4
45°	Nose in	2.5 2.6 2.8	4.9	4.1	2.6 2.4 2.3	7.5 7.3 7.2
30°	Nose in	2.5 2.6 2.8	4.0	3.4	2.4 2.4 2.3	6.4 6.4 6.3
0°	Parallel	2.5	Stall length 6.1m		3.7	

From Table 15A District Plan (all dimensions in metres).



3.2.4 Carriageway Geometrics

All road alignments shall be designed in accordance with the 'Rural Road Design – Guide to the Geometric Design of Rural Roads' and the 'Guides to Traffic Engineering Practice Parts 1 – 14' – Austroads.

3.2.5 Pedestrian and Bicycle Traffic

Footpath shall be 1.5 m width, 125 mm thick concrete using 20 MPa concrete on a 30 mm compacted layer of GAP 20 as a minimum.

Where allowance is to be made within the roadway for a cycle lane then the width of the cycle lane shall be a separated cycle path of 1.5m or combined walking cycle path of 3.0m in a 50km/hr speed zone.

Where two way cycle lanes are to be constructed on berms or on land other than roadway then the minimum width of each cycle lane shall be 3.0m allowing for 1.5m in each direction. Such cycle lanes shall be specifically designed in terms of pavement, geometry and its relationship with other road features including signage, traffic signals etc.

3.2.6 Road Lighting

Road lighting in residential areas is to be designed to provide safety, security and convenience for pedestrians. Accessways in public areas or other locations away from roads should be illuminated and amalgamated with the detailed area plan or layout, enabling visual surveillance of the accessway from the road.

Road and path lighting is to have a high illuminating efficiency and to provide no more illumination than is necessary for security and safety. Road lighting and bicycle or pedestrian path lighting is to be located or mounted so as to minimise light shining upon residential windows, or into the eyes of drivers, pedestrians, or cyclists.

All road lighting requirements are to be installed by the developer and be in operation at the time Council accepts responsibility for the development.

Pedestrian accessways shall have road lights located at each end and shall have lights installed at not more than 50m centres along their length.

Street lights should be placed opposite the centreline of intersecting road at T intersections.

Lighting of roads, service lanes and pedestrian accessways shall be in accordance with NZS 6701 and related documents. The recommendations of Section 9 of NZS 6701 shall apply to all roads and service lanes. NZS 1158 shall be utilised in the design of all lighting.

The lighting category shall be in accordance with the requirements of Table 3.3. Estimated or actual traffic count information is to be provided to support the category chosen for each road. A copy of the As-Built plans is to be provided with the site audit on completion of the commissioning of the lights. Generally poles will be octagonal galvanised poles 6.0 to 7.5m in height and with a 1 or 2m outreach for P4 category and 8 to 10m in height with 1 to 3m outreach for P3 category.

Refer section 1.5.1 for list of minimum information to be submitted.

TABLE 3.3: SUGGESTED CATEGORIES AND SPACINGS

Road (general description)	Basic Operating Characteristic	Minimum Lighting Category	Typical Lighting Installation
Principal (6,000-12,000 vpd)	Commercial area	V3	Dedicated pole (8.3/11.3m) 150W/250W HPS
Collector/Local (3,000-6,000 vpd)	Commercial area	V4/P3	Dedicated (7.3/10.3m), 100/150W HPS
Local (1,000-3,000 vpd)	Residential (busy)	P3	Dedicated or power pole (7.3/8.3m), 100W HPS
Local (200-1,000 vpd)	Residential (average)	P4	Dedicated or power pole (7.3/8.3m), 70W HPS
Local (<200 vpd)	Residential/semi rural (quiet)	P5	Dedicated (6.0/7.3m), 70W HPS

3.2.7 Drainage

A stormwater drainage system shall be installed to cope with a 10% AEP storm. The system shall be designed for the road area and all the contributing catchment. The road may act as a secondary flow path and as a flood retention area for storms greater than the 10% AEP storm. Surface drainage design shall be in accordance with 'Highway Surface Drainage – Design Guide for Highways with a Positive Collection System': National Roads Board, 1977.

All longitudinal drainage pipes including placement of inlets shall be designed to ensure that in a 10% AEP storm event, the maximum spreads of water flow at the kerb channel are limited to:
2.0m at all local roads
2.0m at all sag points
1.5m at all arterial roads

All transverse drainage crossing the roads, such as bridges and culverts shall be designed to pass the 1% AEP peak discharge with the maximum upstream ponding levels at least 500mm below the road crown level assuming no blockage to the entries.

For roads used as overland flow paths as part of new subdivisions, the maximum flow depth shall be limited to 300mm and at least on trafficable land width (in with middle of the road) shall be passable to emergency vehicles.

3.2.8 Landscaping

Berms may be planted provided the placement of the trees complies with the requirements of Papakura District Council Drawings P4 and P5. Similar types of trees should be planted to give a uniform street appearance.

Attention is drawn to Papakura District Council's 'Street Tree Policy', copies of which are available on request. Part 7 of this code provides more detail regarding Council's requirements for landscaping on reserves including road reserve.

3.2.9 Standards and Guidelines

Appendix H provides a complete list of standards and guidelines relevant to the road network of Papakura District, some additional documents are also listed for information.

3.2.10 Bylaws

Bylaws do or may affect the development of, or impact on the road network of Papakura District Council. These bylaws have been developed to protect the community and the environment. The bylaws that do or may impact on roads include:

- Collection and Transportation of Refuse Bylaw 2006
- Operative Traffic and Parking Bylaw 2007
- Speed Limit Bylaw 2004
- Schedule for Speed Limit Bylaw
  - Map – Speed Bylaw A1
  - Map – Speed Bylaw A2
  - Map – Speed Bylaw B1
  - Map – Speed Bylaw B2
- Control of Advertising Signs Bylaw 208
- Water Supply Bylaw 2008
- Waste water Bylaw 2008
- Stormwater Bylaw 2008

3.3 ENGINEERING DESIGN

3.3.1 Road Geometry

Road configuration shall comply with the requirements of the District Plan. All roads in the District shall be designed and constructed such that they can be used by emergency vehicles at all times, thus, the minimum unimpeded carriageway width, taking all legal parking options into account, will be 3.5m between the parked vehicles.

3.3.2 Longitudinal Gradients

The choice of a longitudinal gradient will depend principally on the type of terrain. The volume and extent of earthworks in developments is influenced by the maximum and minimum gradients adopted. The minimum acceptable gradient will normally be 0.5%, but in exceptional conditions, a flatter minimum gradient may be accepted. Road gradients should not be steeper than 1:8 (i.e. 12.5%). On all roads likely to carry significant volumes of public transport or heavy vehicles, the maximum gradient should not be above 8%. For cul-de-sac and minor local roads Council may on application approve steeper grades to a maximum of 1:6, cul-de-sac heads however shall have a maximum grade of 1:12 (i.e. 8%). Where grades steeper than 12.5% are unavoidable, they should be restricted to sections of the road alignment that are straight and should be kept as short as possible. In special cases the Council may by special order procedure approve steeper gradients.

3.3.3 Vertical Curves

Vertical curves shall generally comply with the minimum requirements of 'Rural Road Design – Guide to the Geometric Design of Rural Roads: Austroads, 1989' and 'Guide to Traffic Engineering Practice, Part 1-14: Austroads, 1988' for urban roads. Shortening of undervertical (sag) curves may be necessary to ensure that the gradient in the channel is not less than 1:500. Shortening of the vertical curve on a road adjacent to intersections may be required where the gradient of the road is more than 5%. Change of grade in flat land should have vertical curves of 60 m minimum length where drainage permits.

The safe stopping sight distance (SSSD) shown in Table 3.4 shall apply to all roads, unless specifically advised otherwise by the Engineer.

The safe stopping sight distance is the minimum line of sight distance measured from the driver's eye, 1.15 metres above the road, to an object on the road situated in the centre of the same traffic lane.

TABLE 3.4: SAFE STOPPING SIGHT DISTANCE

	SAFE STOPPING SIGHT DISTANCE (metres)**		
* Operating Speed (km/h)	*** < 1,000 v.p.d.	*** 1,000 - 3,000 v.p.d.	*** > 3,000 v.p.d.
40	30	70	70
50	40	90	90
60	55	115	115
70	85	140	140
80	105	175	175
90	130	210	210
100	160	250	250
110	190	290	290
120	230	330	330

* Operating Speed = 85th percentile speed on frontage road. This can be taken as the speed limit plus 15% if survey data is not available.

** Distances are based on the Approach Sight Distance and Safe Intersection Sight Distance tables in Austroads, Intersections At Grade (1) assuming Reaction Times of 1.5 seconds on local roads with operating speeds up to 60 km/h and 2.0 seconds for all other speeds and all collector and arterial roads.

*** The ultimate v.p.d. are the traffic volumes on the road at the intersection with the highest vehicular count and not necessarily the vehicular count on the road being considered.

3.3.4 Horizontal Curves

Where curves of less than 60m radius are necessary for topographical or other reasons extra widening of between 0.5m and 1.5m shall be applied according to the width of carriageway normally available to moving traffic, the radius of curvature and to the traffic function of the road. Should it be necessary to preserve the minimum berm width extra widening shall also be applied to the land set aside for road.

In urban residential areas horizontal curves may be circular with a minimum centreline radius of 45m, in short cul-de-sacs less than 100m this may be reduced to 15m. For collector routes curves should be a minimum of 80m in radius.

For all industrial areas horizontal curves may be circular with a minimum centreline radius of 80 metres. Local non collector roads of less than 2,000 vehicles per day the radius may be progressively reduced to a minimum of 15 m as traffic volume decreases.

In roads which may have a higher speed limit in the future, the Engineer may require transition curves with a specified speed value. Transition curves shall be calculated in accordance with clause 3.5 of the NRB Code of Practice Design for Urban Streets. Transition curves will not normally otherwise be required in local roads.

3.3.5 Superelevation and Crossfall

Normal camber of 3% shall be used in 50 km/hr zones, or in areas that, in the opinion of the Engineer, are likely to become 50 km/hr zones, except where superelevation is required by the Engineer. In the future, certain roads may have increased speed limits, if this is a possibility, the Engineer may require superelevation to be constructed to a speed value nominated at the time of the request. Any superelevation shall comply with Austroads Rural Road Design.

Superelevation requirements may require adjustment to ensure flowing kerb profiles. Generally the best results are obtained from a graphical plot of each kerb profile, using a horizontal/vertical scale ratio of the order of 10 to 1.

The ruling profile gradient is to be developed along the shortest or inside kerb. Where applicable, superelevation is added to the inside profile to obtain the profile of the outside kerb.

Reverse curves are to be separated by sufficient length of straight to allow for a satisfactory rate of superelevation reversal, consistent with the design standards.

Crossfall to assist surface drainage shall be applied at the following rates:

Sealed pavement	3%
Unsealed pavement	6%

Superelevation appropriate to the design speed shall be applied on all horizontal curves. The superelevation shall not exceed 10%.

3.3.6 Carriageway Crossfall

The normal crossfall shall be 3% in both directions at right angles to the carriageway centreline.

Where a differential level between kerblines is adopted to suit the existing topography of adjoining private property, crossfalls varying from 2% to 4% from the crown may be permitted, coupled with a lateral shift in crown position of up to one quarter of the carriageway width. Where a uniform crossfall is adopted from kerb to kerb this should not exceed 6% unless on a curve where superelevation would otherwise be permitted.

3.3.7 Intersection Design

The preferred angle of intersection is 90° although for secondary roads a minimum angle of 70° may be justified by other constraints. Carriageway alignment may be offset within the street reserve to improve the intersection. Adequate sight distance is to be provided. T-intersections shall be offset from each other in accordance with Austroads requirements (typical stagger distant in the range of 15m to 30m). Cross road intersections on main roads are discouraged.

All residential road intersections of collector/collector class and below shall have a minimum kerb radius at intersection of 9m. Such intersections shall also have the lot corners splayed by a minimum of 6m along both boundaries.

All road intersections above collector/collector class as well as any intersection within commercial/industrial zoning shall have a minimum kerb radius of 13.5m and shall have corner splays or 6m. Heavy industrial intersections shall be the subject of special design.

Except for the above minimum specific requirements, intersections shall be detailed to satisfy Austroads *Guide to Traffic Engineering Practice Part 5: Intersections at Grade.*

In addition to the District Plan, Transit New Zealand document 'Planning for a Safe and Efficient State Highway Network under the Resource Management Act 1991' is to be consulted in the selection of intersection layouts.

The designer shall show on the engineering plans, the sight distance provided at each intersection, plus the following information:

- Design speed
- Design Vehicle
- LV – Distance from limit lines to viewpoint
- ASD – Approach Sight Distance
- ESD – Entering Sight Distance
- SISD – Safe Intersection Sight Distance
- All radii.

For the SISD determination an object height of 0.6m shall be used. Roundabouts shall be designed in accordance with Austroads Guide to Traffic Engineering Practice Part 6 – Roundabouts.

The size of a roundabout has a significant role in the performance for capacity, traffic safety and turning movements of vehicles.

Roundabouts shall be designed in accordance with Austroads Guide to Traffic Engineering Practice, Part 6, Roundabouts. The following minimum design criteria shall be applied:

TABLE 3.5: MINIMUM DESIGN CRITERIA FOR ROUNDABOUTS

Road Type	Central Island Diameter	Circulating Width	LV Distance
Local Road	16m including a 2m concrete collar	Single lane – 7.0m	5.0m
Collector Road Industrial	20m including a 2m concrete collar	Single lane – 7.0m Dual lane – 10.5m	9.0m
Arterial Road	24m including a 2m concrete collar	Single lane – 7.0m Dual lane 10.0m	9.0m

The edge of seal radius at an intersection shall be not less than 15 m in rural areas and face of kerb radius shall be not less than 10m in urban areas. Lesser radius kerbs down to a minimum of 6m may be permitted subject to the approval of the Engineer.

Wherever practicable the longitudinal gradient within 30m of intersections should be less than 5% and preferably less than 2%.

All major intersections shall be designed to accommodate heavy vehicle usage. Turning circles for a 15m truck and trailer unit will be used for design purposes unless specified otherwise by the Engineer. The Engineer shall decide if each intersection falls within the category of a major intersection.

Where traffic islands are deemed necessary at intersections these shall be specifically designed and shall be lit during the hours of darkness. Appropriate lighting shall be specifically designed for the site.

Intersections on curves, particularly on the inside of curves, should be avoided.

The requirements of the TNZ Manual of Traffic Signs and Markings shall be met for priority intersections, as either “Give Way” or “Stop”.

All side roads which have direct access to an arterial road (primary or secondary) either existing or proposed, shall be channelised using either kerb extensions and/or a central throat island at the intersection with the arterial road.
Visibility at intersections shall be to Austroads standards.

The designer shall submit evidence supporting that the design will meet capacity, safety and turning movements of intended vehicles.

Traffic modelling shall show that the design can mitigate the effects of traffic generation due to the development. Where applicable, consideration should be given for future network growth and development. This could include intersection modelling using software such as SIDRA.

Prior to submitting Engineering Plans the designer shall have a Stage 3 “Detailed Design” current version of Transfund’s Safety Audit Procedures completed by an approved auditor. Any issues rated as serious must be rectified prior to submitting Engineering Plans. Items rated important will be evaluated and considered for inclusion with consent conditions.

3.3.8 Cul-de-Sac Heads

The cul-de-sac head in residential areas shall incorporate a minimum 10m outside radius turning circle and a minimum 12.5m outside radius if buses are likely to enter. In industrial areas a 12.5m outside radius will be permitted. In both residential and industrial areas the maximum grade of the cul-de-sac head shall be 8%.

In residential areas alternative turning areas of lesser radius or using T, L or Y shaped heads that may require a reversing movement of vehicles) may be used at the discretion of the Engineer. Specific design of the cul-de-sac, vehicle crossings and footpath will be required and consideration is to be given to pedestrian safety, protection of services and the District Plan. These are to have a maximum grade in the turning area of 3%.

The cul-de-sac shall have sufficient grade to ensure that ponding of water does not occur.

Parking shall be provided at the ratio required by Table 3.1 for every lot around the cul-de-sac head to the dimensions contained in Table 3.2. Any central area provided for parking or beautification should be specifically designed.

3.3.9 Crossfall on Grass Berms

The shape, slope and vegetation of berms shall be such as to provide satisfactorily for stormwater runoff, maintenance, location of services and vehicle crossings to properties (unless acceptable alternative parking is provided). To achieve satisfactory drainage the crossfall should be at least 3%.

Grassed areas for tree planting which are additional to the minimum berm width shall be specifically designed, in these areas steeper gradients may be permitted to a maximum of 20% providing the area can be mown or otherwise maintained by Council.

3.3.10 Road Pavement

Design Life
The pavement shall have a design life of not less than 25 years. Attention is drawn to Papakura District Council's document 'Building Roads on Peat'. This document provides some essential guidelines regarding the construction of roads in the peat districts of Papakura. The following types of pavement may be used within Papakura District:

Flexible Pavement
All flexible pavements shall be designed in accordance with the Austroads Pavement Design Guide and the New Zealand Transport Agency Supplement. The designer shall produce a 'Pavement Design Report' which shall include:
- Results of soils investigations
- Design assumptions and figures
- QA measures and recommendations for construction.

Rigid Pavement
All rigid pavements shall be designed in the Austroads Pavement Design Guide and the New Zealand Transport Agency Supplement.

Pavement Units
With adequate support solid masonry paving units may be accepted in normal roadway situations and may also be a suitable alternative in light duty areas such as shopping malls and courtyards, where surface appearance is a consideration. For design information refer NZS 3116.

Masonry units so designed as to enable grass to grow through the surface will not be accepted for berm parking on road reserve.

CBR Tests
CBR values shall be determined in the laboratory according to NZS 4402: 1986 Section 6.1. Samples should be manufactured in the laboratory to a dry density equal to that in the field. The CBR values used in the pavement design shall be soaked values unless otherwise approved by the Engineer. Other values may be submitted for approval with sufficient evidence with reference to equilibrium moisture content to show that the value chosen should be the minimum strength value likely to be achieved by the subgrade material over the life of the pavement.

The CBR value used in the design shall be the 10-percentile value of the CBR tests taken on the subgrade material. The subgrade is the top one metre of material, either occurring naturally on the site or imported, on which the pavement is constructed.

To obtain the 10-percentile value, collate CBR test results from samples taken at the same level relative to the subgrade.

Where CBR values are required for aggregates these shall be based on laboratory tests prepared on the fraction passing the 19 mm sieve.

Subgrade improvement may be possible by re-compaction of the subgrade, chemical stabilisation or removal and replacement of soft material.

Aggregate requirements are presented in Table 3.6.

TABLE 3.6: PAVEMENT AGGREGATE REQUIREMENTS

Road Type	Traffic Volume	Basecourse Type	Sub-base Type
Arterial Roads	All	AP40	GAP 65
Collector Roads	>2000 vpd	AP40	GAP 65
	<2000 vpd	PAP40	GAP 65
Local Roads	>2000 vpd	AP40	GAP 65
	150-2000 vpd	PAP40	GAP 65
	<150 vpd	GAP 40	GAP 65

The aggregate strength and quality, grading envelopes and aggregate grading shape control are specified in Tables 3.7, 3.8 and 3.9.

SUMMARY SCHEDULE OF AGGREGATE MATERIAL PROPERTIES

TABLE 3.7: AGGREGATE STRENGTH & QUALITY

Material Description	Crushing Resistant	Weathering Resistance	Sand Equivalent
TNZ M/4 1995 (AP40)	130 kN	AA, AB, AC, BA, BB, CA	40
PAP 40	130 kN	AA, AB, AC, BA, BB, CA	34
PAP 20	130 kN	AA, AB, AC, BA, BB, CA	34
GAP 65	110 kN	AA, AB, AC, BA, BB, CA, CB	28
GAP 40	110 kN	AA, AB, AC, BA, BB, CA, CB	25

TABLE 3.8: AGGREGATE GRADING ENVELOPE
(Test Method NZS 4407 Test 3.8.2 Dry Sieving)

	Percentage Passing			
Test Sieve Aperture	TNZ M/4 (AP 40)	GAP 65	PAP 40 GAP 40	PAP20
63.0 mm	-	100	-	-
37.5 mm	100	70-85	100	
19.0 mm	66-81	46-68	63-81	100
9.5 mm	43-57	31-54	41-57	52-75
4.75 mm	28-43	20-41	26-43	31-55
2.36 mm	19-33	13-32	18-33	21-42
1.18 mm	12-25	9-23	11-25	13-31
600 micron	7-19	6-16	6-19	7-23
300 micron	3-14	3-12	3-14	5-16
150 micron	10 max	10 max	10 max	12 max
75 micron	7 max	6 max	7 max	8 max

TABLE 3.9: AGGREGATE GRADING SHAPE CONTROL

	Percentage of Material in Fraction			
Fractions	**TNZ M/4 (AP 40)**	**GAP 65**	**PAP 40 GAP 40**	**PAP20**
37.5 - 9.5 mm	-	24-46	-	-
19.0 - 4.75 mm	28-48	15-37	27-49	-
9.5 - 2.36 mm	14-34	10-31	13-34	19-47
4.75 - 1.18 mm	7-27	7-25	7-28	8-35
2.36 mm - 600 micron	6-22	6-19	6-22	6-27
1.18mm - 300 micron	5-19	5-16	5-19	3-21
600 - 150 micron	2-14	2-12	2-14	2-17

The use of alternative aggregates in forming a stabilised pavement may be permitted with the approval of the Engineer subject to specific design and a minimum treated soaked CBR of 100 is obtained.

Limerock shall not be accepted as GAP 65 aggregate.

Pavement-layer Construction
The minimum pavement depth on unmodified sub-base is 250mm.

Sub-base
When the subgrade is completed and ready for the placing of the pavement layers it shall be inspected by the Engineer. The Engineer shall require the subgrade to be inspected under the action of the compaction equipment or to be tested with Benkelman Beam tests.

The lower basecourse or sub-base shall be spread, graded and rolled to the correct formation level. The completed sub-base shall be inspected and approved by the Engineer prior to placement of the basecourse.

Use of Woodhill Sand

The use of Woodhill sand is not favoured by the council with preference given to the metal pavement being increased, but has been accepted as a means of subgrade improvement where subgrade CBR results may warrant it.

During the design of the road aggregate depths, the use of the sand is to be assumed to achieve a CBR of 4 or less.

As an example; if the road design requires 450mm of metal for a CBR of 4 the minimum metal depth for any part of the road construction is to be 450mm. If the actual site CBR is found to be 2, then if appropriate, one may decide to use 300mm of Woodhill sand with a minimum depth of 450mm metal.

In all cases an absolute minimum metal depth is to be 350mm to ensure future rehabs do not result in disturbance of the sand or geotextile reinforcements that may also be used. The minimum depth of Woodhill sand is to be 300mm.

In all cases where sand is used, geotextile cloth is to be used as required by Councils engineer. The under-channel drainage pipe shall also be installed within a filter sock.

Basecourse
The basecourse layer shall be placed to full depth compacted and graded to shape at the optimum moisture content.

Benkelman Beam tests shall be completed on the pavement before surfacing. The test axle load shall be 8.2 tonne.

Where 5% of readings exceed the stated Maximum Reading in Table 3.10, or any individual reading is more than twice the Maximum Reading, the length of pavement concerned shall be reconstructed to conform to this standard.

TABLE 3.10: MAXIMUM BENKELMAN BEAM CHART

Road Type	Maximum Reading (mm)
All roads with less than 300 v.p.d. potential traffic generated - except industrial roads	2.0
Local Roads	1.5
Arterial and Collector Roads and all roads in industrial areas	1.0

Where underlying deflection is evident the amount shall be determined following completion of specified testing by the Engineer and the resultant pavement deflection compared with the above table.

When subgrades have been modified with lime or cement the Engineer shall require Benkelman Beam uniformity testing prior to the application of pavement aggregates.

All testing required under these clauses shall be at the cost of the developer.

Surface Sealing
Immediately prior to any form of surfacing a strip 600mm wide adjacent to each channel shall be sprayed with an approved ground sterilising weed killer at the manufacturer's recommended rate of application.

All residential and Industrial roads, shall be finished in hot laid asphaltic concrete over a one coat chip seal, unless otherwise approved by the Engineer.

All rural roads shall be finished in first and second coat chip seals, unless otherwise approved by the Engineer.

First and Second Coat Chip Seals
First coat sealing with asphaltic cutback shall be to TNZ specifications P/3 and M/1. Sealing chips used are to comply with the TNZ specification M/6 provided that local stone may be used where the loss by the Los Angeles abrasion test does not exceed 40%.

The developer may either complete both seal coats at the time of construction or may negotiate for the Council's Contractor to complete the second coat seal within 12 months at the developer's full cost.

Where the second coat seal is to be laid after the development is formally accepted by the Council a bond will be required pursuant to this code.

Hot Laid Asphaltic Concrete Surfacing
All roads, cul-de-sacs and service lanes shall be surfaced with a minimum compacted thickness 30mm of asphaltic concrete complying with TNZ Specification M/10. The method of laying is specified in TNZ P/9. The 30mm thickness shall be the total depth from the top of the metal basecourse to the hotmix surface.

A first coat chip seal shall first be applied to the prepared basecourse surface at least one month before the asphaltic concrete surfacing is laid. The chip seal shall use either grade 3 or grade 4 chips. The first coat seal shall use an appropriate asphaltic binder, but with the requirement of a minimum of 1.0 l/m² residual penetration grade bitumen.

Asphaltic surfacing of new road pavements at heavily trafficked intersections shall require special consideration and may require specific design.

If, in the opinion of the Engineer, any newly constructed road is deemed to be rough, the Developer shall arrange for roughness tests of the completed pavement.

Roughness
Road roughness for finished pavements shall be in accordance with Transit NZ requirements (refer TNZ Technical memorandum No. TNZ TM 7003 VI).

3.3.11 Traffic Services

All road construction will require the installation of appropriate painted road markings and delineation aids. The Engineer will specify the requirements in each case. All traffic service installations shall be in accordance with Transit New Zealand's Manual of Traffic Signs and Markings.

Painted road markings shall be reinstated following the application of the second coat seal and the cost shall be included in the Bond (if any).

Once the road names have been approved by the Council the developer shall arrange through the Council's road signs contractor the erection of the appropriate signs and shall meet all charges incurred. Refer to Papakura District Council Drawing R1.

3.3.12 Bridging

Should bridging be necessary, early discussions should be held with the Engineer.

Bridge design shall conform to the technical requirements of the New Zealand Transport Agency's Bridge Design Manual.

The width between kerbs or wheelguards shall be as set out in Table 3.9.

All bridges and all box culverts with a waterway area greater than 1.5m^2 may be subject to a Building Consent under the Building Act 1991.

Traffic guard rails of an approved type and layout shall be installed over the culvert embankment.

For a culvert, the design shall allow for the passage of the 10 year flood without heading up. The design shall allow for the passage of the 100 year flood by heading up to a maximum level 0.5m below the road surface, but not more than 2m above soffit level. Where the road crosses a defined flood plain and overtopping is to be provided for, specific design shall be provided to the satisfaction of the Engineer. If the heading up condition is considered, the design shall ensure embankment stability under flood conditions, and adequate protection to safeguard against piping. This clause includes accessways and right of ways.

In all cases where heading up or overtopping is a design feature, attention shall be given to back water effects upstream to ensure that flooding of adjoining land is not adversely affected.

Installation of bridges or culverts on natural watercourses is generally subject to a Resource Consent from the Auckland Regional Council. The design and construction shall comply in all respects with the requirements of the Consent. In some cases the works may be covered by General Authorisations and not require consents. The advice of the relevant Regional Authority should be sought at an early stage.

3.3.13 Subgrade Drainage

Underground Drainage
Subsoil drains are required under all road channels, standard kerb lines, along kerb lines on medians, round-abouts and traffic control islands. The underchannel drains shall consist of an approved filter drainpipe 100 mm diameter wrapped in a filter cloth/sock in a trench backfilled with an approved free-draining material. The trench shall be 300 mm wide, the pipe invert not less than 600 mm below subgrade level, the trench bottom 50 mm below pipe invert.

Additional Subgrade Drainage
Any wet spot in the subgrade shall be drained to the underchannel drainage system. Where the wet area is below the level of the underchannel drain, it shall be drained using approved filter drainpipes connected to the nearest stormwater system.

3.3.14 Kerbing and Channelling

Where kerbs and channels, or equivalent approved concrete, ceramic or stone edging, are to be provided on carriageways, they are to comply with standard Papakura District Council Drawing R16. Cast in situ concrete shall be to NZS 3109 with a 28 day strength of 20 MPa.

String lines set up for kerbing shall be inspected and approved by the Certifying Engineer prior to construction.

Where crossfall is such that stormwater control is required on one side only of the carriageway, kerb and nib only may be installed on the higher side.

3.3.15 Catchpits

Catchpits shall be spaced to provide for local rainfall intensities and the channel slope. Typical spacings are:

(a) In channels draining one lane, in such a position that the run of water in any channel is a maximum of 90 m, for channels draining two lanes, a maximum of 60 m.

(b) Where required at intersections, at the kerbline tangent points.

(c) At changes of gradient or direction in the channel where there may be a tendency for water to leave the channel.

(d) A double catchpit shall be provided:

- At the lowest point in a sag vertical curve;
- At the end of a cul-de-sac where water falls to the end.

Catchpits should normally be connected to a manhole on the stormwater drainage system by 225mm minimum diameter pipes, (double catchpits require a 300mm minimum diameter pipe) except that if the stormwater drain is of greater diameter than 1.2metres and a manhole is not conveniently located the catchpit lead may be saddled direct to that drain. A direct connection of the catchpit lead to a stormwater drain with a diameter between 600m and 1.2 metres diameter will only be permitted in exceptional circumstances, and at the Engineer's discretion. A range of typical catchpit designs is shown in Papakura District Council Drawings R17, R18, and R19.

On footpaths and accessways, catchpits, if not required to take a design flow of more than 15 litres per second may be 450mm by 450mm internal dimensions. An outlet of at least 150mm diameter will be required, refer PDC Drawing R17.

3.3.16 Dished Channels

Dished Channels in Carriageways and Parking Bays
To provide setback parking a 600mm wide dished channel shall be constructed and shall be as set out in Papakura District Council Drawing R16.

Dished Channels with Footpaths or Accessways
Low level footpaths and footpaths in pedestrian accessways shall have a dished channel formed along the path edge. The channel shall lead to a 450mm x 450mm catchpit as set out in Papakura District Council Drawing R17.

3.3.17 Footpaths/Accessways

Construction of Footpaths
Concrete footpaths shall be constructed of concrete to NZS 3109 with a 28 day strength of 20MPa. The minimum depth of concrete shall be 100mm. A minimum 30mm compacted depth of fine granular material shall be placed under the concrete. Where mountable kerbs are used minimum depth of concrete shall be 125mm. The width shall be 1.5m. The minimum crossfall on any footpath shall be 2%. Solid masonry paving units may be used providing permanent concrete edgings are used.

Footpaths in shopping areas shall be specifically designed for the particular circumstances which apply.

For details of fencing and bollard requirements for pedestrian accessways refer to Papakura District Council Drawings P1 & P2.

In general footpaths are to be located away from the kerb (not adjacent to the kerb).

Footpaths in cul-de-sac that form part of the required cul-de-sac turning area shall be 200mm thick.

Footpath construction joints or saw cuts to a minimum depth of 30 mm shall be formed at 4m centres.

Accessways
All accessways shall be constructed to the same standard as footpaths.

3.3.18 Crossings

Pram and Wheelchair Crossings
Wheelchair ramps shall be constructed as shown on Papakura District Council Drawing R21. Maximum gradient shall be 1 in 12. Where required by the Engineer a contrasting surface shall be constructed on the ramp in accordance with NZS1428.4 "Design for access and Mobility".

The crossings shall be sited to facilitate normal pedestrian movements in the road. Where possible catchpits shall be sited so as to reduce the flow of stormwater in the channel at the crossing entrance.

Vehicle Crossings
A vehicle crossing shall be provided between the kerbline and the property boundary at the entrance to all entrance strips to rear lots, privateways and service lanes and at any other place where the location of the future driveway to a section can be determined with reasonable certainty. Details of recommended forms of crossing are indicated in Papakura District Council Drawings R4, R5, R6, R7 and R8.

Where crossings may be expected to carry heavy traffic, these shall be specifically designed and the depth increased or reinforcing provided, or both, to the Engineer's satisfaction.

Concrete driveways shall not exceed a gradient of 20%. Changes of gradient shall be in accordance with Papakura District Council Drawing R9.

The maximum permitted number of vehicle crossings in areas zoned “Residential” in the Papakura District Plan is one crossing per Lot, and two crossings per Lot in areas zoned “Commercial and Industrial”.

Council are keen to minimise the amount of concrete surfaces within the berm and also provide space between vehicle access points. A minimum of 1.5m separation between neighbouring vehicle crossings is to be provided wherever possible.

3.3.19 Berms

The minimum width of berm shall be as given in Table 3.1.

On completion of all other works, the berms shall be spread with a consolidated depth of 100 mm of quality topsoil. The topsoil shall be graded to kerb top and footpath edges, and may be finished 15 mm high to allow for settlement except on the low side of the footpath where the topsoil shall be finished flush to prevent water ponding.

After topsoiling the berms shall be sown with amenity type rye grass seed and fertilised.

3.3.20 Service Lanes, Parking Bays, Privateways, Accessways and Cycle Paths

Service Lanes
Service lanes shall have a kerb and channel on at least one side, a concrete edging strip flush with the surface may be used on the other side. Provision shall be made for the disposal of stormwater. The pavement construction and surfacing shall be in accordance with 302.2.

Industrial Service Lanes
Industrial service lanes and private ways shall be subject to specific design.

Where an industrial service lane serves properties on one side only, the surface may have a single crossfall with kerb and channel on the lower side and a concrete edging strip flush with the surface on the high side.

Parking Bays
Parking bays shall be constructed to the same design standards as the roads of which they are a part.

Pedestrian Accessways
Pedestrian accessways shall be paved to their full width when the pedestrian accessway is less than 1.8m wide. When the pedestrian accessway is wider than 1.8m the width of paving shall be 1.5m.

Where stormwater is likely to flow along the length of the pedestrian accessway, provision shall be made for the collection and disposal of stormwater.

Both sides of a pedestrian accessway should be bounded by a fence to a standard not less than as shown on Papakura District Council Drawing P2.

Steep grades shall be avoided as far as practicable. Where grades exceed 1 in 6 or steps proposed the prior approval of the engineer is required.

Privateways
The minimum widths between boundaries shall be as in the District Plan and shall include a grassed strip on either side to provide for the construction of underground services.

Privateways are to be constructed in accordance with the details set out in Papakura District Council Drawing G1. Alternative construction details will be permitted at the discretion of the Engineer.

Pavement shall be constructed of 150mm thick concrete. The width shall be as laid down by the District Plan.

Adequate provision shall be made for the collection and disposal of stormwater to a piped system.

Adequate turning area shall be provided on all privateways. Passing bays shall be provided where there is not a clear line of sight from one end to the other, in which case the passing bay shall be located at a point visible to either end. Gradients shall not exceed 1 in 5. Transverse slope shall be 3% and the minimum inside radius of curves shall be 6m.

Cycle Paths
Paths for bicycle use shall be constructed to standards specified for footpaths. Stormwater disposal, fencing, handrails, lighting shall be provided as appropriate to the specific situation.

Bus Stops
On roads that are likely to become future bus routes bus stops shall be installed. Bus stops are to be in accordance with the "Bus Stop Infrastructure Design Guidelines May 2009" published by the Auckland Regional Transport Authority (ARTA).

Utility Services within Urban Road Reserve
Services installed within the road land shall be confined to the locations indicated on Papakura District Council Drawing R2, or as specified in NZS 4404.

8.1.5 Power Transformers, Switching Stations and Other Services

Power, telecom, gas or other service boxes, transformers, valves, switches or similar devises larger than 300mm x 300mm are to be placed within private property clear of Councils stormwater and sewer pipes and access is to be provided by way of an easement over the private property for the Utility Companies.

8.1.6 Conversion to Underground on Existing Roads

Where a proposed development fronts on to an existing road, the conversion of overhead reticulation to underground will in some instances be desirable. Agreement on the feasibility and benefit will first be agreed between the network company and the Council.

8.1.7 Industrial and Commercial Developments

The servicing requirements for industrial and commercial areas are often indeterminate. Close liaison between the developer and the network company is advisable, particularly immediately before cabling is installed so that changes can be incorporated to accommodate extra sites or the requirements of a particular industry.

8.2 LOCATION AND BACKFILLING OF SERVICES

8.2.1 Location

The position of services in the road shall conform to Papakura District Council Drawing R2. All services shall be within 100mm of the recommended location.

8.2.2 Backfilling of Trenches

Trenches shall be built up with an approved backfill material in 150mm layers placed and compacted simultaneously on each side of the pipes, in order to give a balanced loading. Full use shall be made of hand operated compaction tools.