QUEENSTOWN LAKES DISTRICT COUNCIL

Queenstown Lakes District Council

Land Development and Subdivision Code of Practice

Superseding NZS 4404:2004 and Council Amendments

(Only applies to Queenstown Lakes District Council's subdivision and development design standards)

Queenstown Lakes District Council

Land Development and Subdivision Code of Practice

This document supersedes all previous Queenstown Lakes District Council subdivision and development design standards adopted by Council prior to 28/05/2015

Document History

	Date	Prepared	Approved
Content adopted by Council	03/06/15	R Flitton – Principal Resource Management Engineer	Full Council
Amendment to water supply requirements	17/08/15	R Flitton – Principal Resource Management Engineer	Ulrich Glasner - Chief Engineer
Amendment road safety audit requirements for private networks	24/08/15	Keri Garrett – Senior Resource Management Engineer	R Flitton – Principal Resource Management Engineer
Requirement for sumps to be fitted with siphons	24/08/15	Mike Healy – Resource Management Engineer	R Flitton – Principal Resource Management Engineer
Vehicle Crossing types added	07/09/15	Lyn Overton – Resource Management Engineer	R Flitton – Principal Resource Management Engineer
Amendments as per requirements from Standards NZ	7/10/15	Polly Lambert – Policy, Standards & Assets Planner	K Garrett – Senior Resource Management Engineer
Water connection requirements added	30/10/15	K Garrett – Senior Resource Management Engineer	Polly Lambert – Policy, Standards & Assets Planner

Contents

REFERENCED DOCUMENTS

Reference is made in this document to the following:

NEW ZEALAND STANDARDS

NZS 1170:- - - -	Structural design actions
Part 5:2004	Earthquake actions – New Zealand
Part 5 Supp 1:2004	Earthquake actions – New Zealand – Commentary
NZS 3109:1997	Concrete construction
NZS 3114:1987	Specification for concrete surface finishes
NZS 3116:2002	Concrete segmental and flagstone paving
NZS 3604:XXXX	Timber-framed buildings (in preparation)
NZS 4402:- - - -	Methods of testing soils for civil engineering purposes
Part 6:1986	Soil strength tests
NZS 4405:1986	Helical lock-seam corrugated steel pipes
NZS 4406:1986	Helical lock-seam corrugated steel pipes – Design and installation
NZS 4431:1989	Code of practice for earth fill for residential development
NZS 4442:1988	Welded steel pipes and fittings for water, sewage and medium pressure gas
NZS 5828:2004	Playground equipment and surfacing
NZS/AS 1657:1992	Fixed platforms, walkways, stairways and ladders. Design, construction and installation
NZS/BS 750:1984	Specification for underground fire hydrants and surface box frames and covers
SNZ HB 5828.1:2006	General playground equipment and surfacing handbook
SNZ PAS 4509:2008	New Zealand Fire Service firefighting water supplies code of practice

JOINT AUSTRALIAN/NEW ZEALAND STANDARDS

AS/NZS 1158:- - - -	Road lighting
Part 0:2005	Introduction
Part 1.1:2005	Vehicular traffic (category V) lighting – Performance and design requirements
Part 1.3:1997	Vehicular traffic (category V) lighting – Guide to design, installation, operation and maintenance
Part 3.1:2005	Pedestrian area (category P) lighting – Performance and design requirements
AS/NZS 1254:2010	PVC-U pipes and fittings for stormwater and surface water applications
AS/NZS 1260:2009	PVC-U pipes and fittings for drain, waste and vent application
AS/NZS 1477:2006	PVC pipes and fittings for pressure applications

AS/NZS 1546:- - - -	On-site domestic wastewater treatment units
Part 1:2008	Septic tanks
AS/NZS 1547:XXXX	On-site domestic wastewater management (in preparation)
AS/NZS 2032:2006	Installation of PVC pipe systems
AS/NZS 2033:2008	Installation of polyethylene pipe systems
AS/NZS 2041:1998	Buried corrugated metal structures
AS/NZS 2280:2004	Ductile iron pipes and fittings
AS/NZS 2566:- - - -	Buried flexible pipelines
Part 1:1998	Structural design
Part 1 Supp 1:1998	Structural design – Commentary
Part 2:2002	Installation
AS/NZS 3500:- - - -	Plumbing and drainage
Part 1:2003	Water services
AS/NZS 3518:2004	Acrylonitrile butadiene styrene (ABS) compounds, pipes and fittings for pressure applications
AS/NZS 3690:2009	Installation of ABS pipe systems
AS/NZS 3725:2007	Design for installation of buried concrete pipes
AS/NZS 3845:1999	Road safety barrier systems
AS/NZS 3879:2006	Solvent cements and priming fluids for PVC (PVC-U and PVC-M) and ABS pipes and fittings
AS/NZS 4020:2005	Testing of products for use in contact with drinking water
AS/NZS 4058:2007	Precast concrete pipes (pressure and non-pressure)
AS/NZS 4129:2008	Fittings for polyethylene (PE) pipes for pressure applications
AS/NZS 4130:2009	Polyethylene (PE) pipes for pressure applications
AS/NZS 4131:2010	Polyethylene (PE) compounds for pressure pipes and fittings
AS/NZS 4158:2003	Thermal-bonded polymeric coatings on valves and fittings for water industry purposes
AS/NZS 4441:2008	Oriented PVC (PVC-O) pipes for pressure applications
AS/NZS 4765:2007	Modified PVC (PVC-M) pipes for pressure applications
AS/NZS 4793:2009	Mechanical tapping bands for waterworks purposes
AS/NZS 4998:2009	Bolted unrestrained mechanical couplings for waterworks purposes
AS/NZS 5065:2005	Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications

AUSTRALIAN STANDARDS

AS 1579:2001	Arc-welded steel pipes and fittings for water and waste-water
AS 1741:1991	Vitrified clay pipes and fittings with flexible joints – Sewer quality
AS 1906:- - - -	Retroreflective materials and devices for road traffic control purposes

Part 3:1992	Raised pavement markers (retroreflective and non-retroreflective)
AS 2200:2006	Design charts for water supply and sewerage
AS 2638:- - - - Part 2:2006	Gate valves for waterworks purposes Resilient seated
AS 2700:1996	Colour Standards for general purposes
AS 2870:1996	Residential slabs and footings – Construction

AS 2890:- - - -	Parking facilities
Part 5:1993	On-street parking
AS 3571:- - - -	Plastics piping systems – Glass-reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP) resin
Part 1:2009	Pressure and non-pressure drainage and sewerage
Part 2:2009	Pressure and non-pressure water supply
AS 3681:2008	Application of polyethylene sleeving for ductile iron piping
AS 3996:2006	Access covers and grates

BRITISH STANDARDS

BS EN 295:- - - -	Vitrified clay pipes and fittings and pipe joints for drains and sewers
Part 1:1991	Requirements
Part 2:1991	Quality control and sampling
Part 3:1991	Test methods
Part 4:1995	Requirements for special fittings, adaptors and compatible accessories
Part 6:1996	Requirements for vitrified clay manholes
Part 7:1996	Requirements for vitrified clay pipes and joints for pipe jacking
Part 10:2005	Performance requirements
BS EN 805:2000	Water supply – Requirements for systems and components outside buildings

OTHER PUBLICATIONS

GENERAL

Ministry for the Environment. *New Zealand urban design protocol*. Wellington: Ministry for the Environment, 2005.

EARTHWORKS AND GEOTECHNICAL REQUIREMENTS

BRANZ. *BRANZ Study Report 004, Assessment of slope stability at building sites*. BRANZ and Worley Consultants Ltd, 1987.

Cook, D, Pickens, G A, and MacDonald, G. ‘The role of peer review’, Report by Crawford S A. NZ *Geomechanics News* (Dec 1995).

Crawford, S A, and Millar, P J. ‘The design of permanent slopes for residential building development’, EQC Research Project 95/183, *NZ Geomechanics News* (June 1998).

New Zealand Geotechnical Society Inc. *Field description of soil and rock.* New Zealand Geotechnical Society Inc, 2005.

New Zealand Geotechnical Society Inc. ‘Geotechnical issues in land development’. Proceedings of New Zealand Geotechnical Society Symposium, Hamilton, 1996.

ROADS

Auckland Regional Transport Authority (ARTA). *Bus stop infrastructure design* *guidelines*. Auckland: ARTA, 2009.

Austroads codes and guides, 2009. (Subject to the relevant New Zealand supplement).

Austroads. *Guide to road design – Part 3: Geometric design*. Austroads, 2009.

Austroads. *Guide to traffic management – Part 8: Local area traffic management*. Austroads, 2008.

Cement and Concrete Association of Australia. *Guide to residential streets and paths*. Cement and Concrete Association of Australia, 2004.

New Zealand Transport Agency.

Bridge manual. (SP/M/022) 2nd ed. Wellington: NZTA, 2003.

Cycle network and route planning guide. Wellington: Land Transport Safety Authority, 2004. Available at: http://www.nzta.govt.nz/resources/cycle-network-and-route-planning/cycle-network.html

Pedestrian planning and design guide. Wellington: NZTA, 2009. Available at: http://www.nzta.govt.nz/resources/pedestrian-planning-guide/docs/pedestrian-planning-guide.pdf

Road safety audit procedures for projects (Manual number TFM9). Wellington: Transfund New Zealand, 200

RTS 11: Urban roadside barriers and alternative treatments. Wellington: Land Transport Safety Authority, 1995. Available at: http://www.nzta.govt.nz/resources/road-traffic-standards/docs/rts-11.pdf

RTS 18: New Zealand on-road tracking curves for heavy vehicles. Wellington: Land Transport New Zealand, 2007. Available at: http://www.nzta.govt.nz/resources/road-traffic-standards/rts-18.html

Stormwater treatment standard for state highway infrastructure. Wellington: NZTA, 2010.

NZTA specifications (available at: http://www.nzta.govt.nz/resources/index.html)

B/2:2005	Construction of unbound granular pavement layers
F/2:2000	Pipe subsoil drain construction
F/2 notes:2000	Notes on pipe subsoil drain construction specification
M/1:2007	Roading bitumens
M/4:2006	Crushed basecourse aggregate
M/10:2005	Asphaltic concrete
P/3:1995	First coat sealing
P/4:1995	Resealing
P/9:1975	Construction of asphaltic concrete paving
T/10:2002	Skid resistance deficiency investigation and treatment selection

United Kingdom Department for Transport. *Manual for streets.* London: Thomas Telford Publishing, 2007.

United Kingdom Transport Research Laboratory. *TRL661 – The manual for streets: evidence and research.* TRL, 2007.

STORMWATER, WASTEWATER, AND WATER SUPPLY

Auckland Regional Council

Technical Publication No. 124 (TP124) *Low impact design manual for the Auckland region*, 2000.

Technical Report 2008-20 *Application of low impact design to brownfield sites* (in preparation)

Technical Report 2009-83 *Integration of low impact design, urban design and urban form principles* (in preparation)

Australasian Society for Trenchless Technology (ASTT). *Guidelines for horizontal directional drilling, pipe bursting, microtunnelling and pipe jacking*. Greenwood, Western Australia: ASTT, 2009.

Austroads. *Guide to road design – Part 5: Drainage design*. Austroads, 2008.

Hicks, D M, and Mason, P D. *Roughness characteristics of New Zealand rivers*, Wellington: Water Resources Survey, DSIR Marine and Freshwater, 1991.

Janson, Lars-Eric. *Plastics pipes for water supply and sewage disposal*. 2003.

Lamont, P. 'Metrication: Hydraulic data and formulae.' *Water Services* Volume 81, numbers 972/3/4 (Reprinted by Kent Meters Ltd, UK)

Ministry for the Environment.

Coastal hazards and climate change – A guidance manual for local government in New Zealand. Wellington: Ministry for the Environment, 2008.

Preparing for climate change – A guide for local government in New Zealand. Wellington: Ministry for the Environment, 2008.

Preparing for coastal change – A guide for local government in New Zealand. Wellington: Ministry for the Environment, 2009.

Preparing for future flooding – A guide for local government in New Zealand. Wellington: Ministry for the Environment, 2010.

Tools for estimating the effects of climate change on flood flow – A guidance manual for local government in New Zealand. Wellington: Ministry for the Environment, 2010.

Ministry of Health. *Drinking-water standards for New Zealand 2005 (Revised 2008)*. Wellington: Ministry of Health, 2008.

Najafi, M. *Trenchless technology – Pipeline and utility design, construction, and renewal*. McGraw-Hill, 2005.

New Zealand Transport Agency. *Bridge manual*. (SP/M/022) 2nd ed. Wellington: NZTA, 2003.

New Zealand Water and Wastes Association (Water New Zealand). *New Zealand pipe inspection manual.* Wellington: New Zealand Water and Wastes Association, 2006.

Stein, D. *Trenchless technology for installation of cables and pipelines*. Germany: Stein & Partner, 2005.

Uni-Bell. *Handbook of PVC pipe.* 4th ed. Dallas: Uni-Bell PVC Pipe Association, 2001.

Water Services Association of Australia (WSAA):

WSA 02-2002	Sewerage Code of Australia – 1999 and 2002
WSA 03-2002	Water Supply Code of Australia – 1999 and 2002
WSA 04-2005	Sewage Pumping Station Code of Australia – 2005
WSA 06-2008	Vacuum Sewerage Code of Australia – 2008
WSA 07-2007	Pressure Sewerage Code of Australia – 2007

NETWORK UTILITY SERVICES

Department of Labour. *Guide for safety with underground services*. Wellington: Department of Labour, 2002.

New Zealand Utilities Advisory Group (NZUAG). *National code of practice for utilities'* *access to the transport corridors.* Wellington: NZUAG, 2008.

Note – The NZUAG code of practice is an interim measure until a national code of practice is approved under the Utilities Access Act 2010.

NEW ZEALAND LEGISLATION

The provisions of this Code of Practice shall be read subject to the provisions of regional and district plans and to any applicable statutes, regulations, bylaws, and any subsequent amendments, including (but not limited to):

Building Act 2004, Building Regulations, and New Zealand Building Code (NZBC) 1992

Civil Defence Emergency Management Act 2002

Conservation Act 1987

Health and Safety in Employment Act 1992

Health (Drinking Water) Amendment Act 2007

Historic Places Act 1993

Infrastructure (Amendments Relating to Utilities Access) Act 2010

Land Transfer Act 1952

Land Transport Rule (Traffic Control Devices) 2004

Local Government Act 1974 and Local Government Act 2002

Reserves Act 1977

Resource Management Act 1991

Utilities Access Act 2010

RELATED DOCUMENTS

When interpreting this Code of Practice it may be helpful to refer to other documents, including but not limited to:

GENERAL

Land Information New Zealand. *New Zealand geodetic datum 2000 (NZGD2000)*

Ministry for the Environment. *Climate change effects and impacts assessment – A guidance manual for local government*. 2nd ed. Wellington: Ministry for the Environment, 2008.

EARTHWORKS AND GEOTECHNICAL REQUIREMENTS

Auckland Regional Council. Technical Publication No. 90 (TP90) *Erosion and sediment control: guidelines for land disturbing activities in the Auckland Region.* Auckland: Auckland Regional Council, 1999.

Fraser Thomas Ltd (B J Brown, P R Goldsmith, J P M Shorten, L Henderson) *BRANZ Study Report 120, Soil expansivity in the Auckland region.* Judgeford: BRANZ, 2003.

Ministry for the Environment. *Planning for development of land on or close to active faults – A guideline to assist resource management planners in New Zealand*. Wellington: Ministry for the Environment, 2004.

Sanders, W, and Glassey, P. (Compilers)*. Guidelines for assessing planning policy and consent requirements for landslide prone land,* GNS Science Miscellaneous Series 7. Lower Hutt: Institute of Geological and Nuclear Sciences Limited, 2007.

ROADS

Concrete Masonry Association of Australia. *Concrete segmental pavements – Design guide for residential accessways and roads*. Sydney: Concrete Masonry Association of Australia, 1997.

Jones, P, Boujenko, N, and Marshall, S. *Link and place – A guide to street planning and design*. London: Landor Books, 2007.

Ministry of Justice. *National guidelines for crime prevention through environmental design in New Zealand Part 1: Seven qualities of safer places, and Part 2: Implementation guide*. Wellington: Ministry of Justice, 2005.

Ministry of Transport *Government policy statement on land transport funding 2009/10 – 2018/19.* Wellington: Ministry of Transport, May 2009.

Ministry of Transport. *Safer journeys – New Zealand's road safety strategy 2010 – 2020.* Wellington: Ministry of Transport, 2010.

Ministry of Transport. *The New Zealand transport strategy 2008.* Wellington: Ministry of Transport, 2008.

New Zealand Transport Agency

Traffic note 48 – Light vehicle sizes and dimensions: Street survey results and parking space requirements – Information. Land Transport New Zealand, December 2004. Available at: http://www.nzta.govt.nz/resources/traffic-notes/docs/traffic-note-48.pdf

Manual of traffic signs and markings (MOTSAM) Parts 1 – 4

NZTA register of network standards and guidelines. Wellington: NZTA, 2009. Available at: http://www.nzta.govt.nz/resources/nzta-register-network-standards-guidelines/

SNZ HB 44:2001 *Subdivision for people and the environment.* Wellington: Standards New Zealand, 2001.

STORMWATER, WASTEWATER, AND WATER SUPPLY

Auckland City Council. *On-site stormwater management manual*. Auckland: Auckland City Council, 2002.

Auckland City Council. *Soakage design manual.* Auckland: Auckland City Council, 2003.

Auckland Regional Council. Technical Publication No. 10 (TP10) *Design guideline manual stormwater treatment devices,* 2003.

Auckland Regional Council. Technical Publication No. 108 (TP108) *Guidelines for stormwater runoff modelling in the Auckland region*, 1999.

Christchurch City Council. *Waterways, wetlands and drainage guide – Part A: Visions and Part B: Design.* 2003. Available at: http://www.ccc.govt.nz/cityleisure/parkswalkways/environmentecologywaterwayswetlandsdrainageguide/index.aspx

Environment Protection Authority (EPA) Victoria. *Maintaining water sensitive urban design elements*. Melbourne: EPA Victoria, 2008.

Greater Wellington Regional Council. *Fish friendly culverts*. June 2003. Available at: http://www.gw.govt.nz/bridges-and-culverts/

New Zealand Water Environment Research Foundation (NZWERF) *On-site stormwater management guideline*. Wellington: NZWERF, 2004.

North Shore City Council. *Bioretention guidelines*. Takapuna: North Shore City Council, 2008.

Puddephatt, J, and Heslop, V. *Guidance on an integrated process – Designing, operating and maintaining low impact urban design and development devices*. Landcare Research, July 2008.

Sustainable urban drainage systems (SUDS) design manuals for countries in the United Kingdom

Water sensitive urban design (WSUD) manuals from various Australian states and cities

WEBSITES

Auckland Regional Council	http://www.arc.govt.nz
Austroads	http://www.austroads.com.au
Ministry for the Environment	http://www.mfe.govt.nz
National Pest Plant Accord	http://www.biosecurity.govt.nz/nppa
New Zealand Historic Places Trust	http://www.historic.org.nz
New Zealand Legislation	http://www.legislation.govt.nz
New Zealand Transport Agency	http://www.nzta.govt.nz/
Plastics Industry Pipe Association of Australia:	http://www.pipa.com.au

Trips Database Bureau	http://www.tdbonline.org/home
Water Services Association of Australia	https://www.wsaa.asn.au/

LATEST REVISIONS

The users of Code of Practice should ensure that their copies of the above-mentioned New Zealand Standards are the latest revisions. Amendments to referenced New Zealand and Joint Australian/New Zealand Standards can be found on http://www.standards.co.nz.

REVIEW OF NZS 4404:2010

Suggestions for improvement of NZS 4404:2010 will be welcomed. They should be sent to the Chief Executive, Standards New Zealand, Private Bag 2439, Wellington 6140.

Foreword

A significant proportion of all new infrastructure is created by land development and subdivision projects. As a community, we need to get this right. This is why NZS 4404:2010 aims to encourage good urban design and remove road blocks to liveability and economic development in communities.

Some of the key changes from NZS 4404:2004 are:

(a) That road design needs to allow 'context' or 'place' to be given significant emphasis, and to require roads to achieve safe (slower) operating speeds;

(b) An emphasis on managing and treating stormwater 'before it gets into a pipe', together with a requirement to consider climate change and potential sea level rise;

(c) Grassed swales, natural or artificial waterways, ponds and wetlands, for example, may in certain circumstances be not only part of the stormwater system, but also be a preferred solution, especially if low impact on receiving waters downstream is critical;

(d) The sections on landscaping and reserves have been combined and significantly rewritten; and

(e) The section on utility services (section 8) has also been significantly amended in accordance with the latest network authorities' codes.

The change in the title from 'engineering' to 'infrastructure' signals that good subdivision design involves a multidisciplinary collaborative approach. NZS 4404 was first published in 1981 as the Code of practice for urban land subdivision. In 2004 it became the Standard for Land development and subdivision engineering. In response to submissions on the draft 2010 version, and to clarify the place and role of NZS 4404, the committee has decided that the new name, Land development and subdivision infrastructure, best reflects its function.

NZS 4404:2010 is applicable to greenfield, infill, and brownfield redevelopment projects. It provides local authorities (LAs) and developers a Standard for the design and construction of subdivision infrastructure. It can be used on its own or, together with local codes, as a means to comply with Resource Management Act (RMA) consent conditions. It is not an urban design policy, guide, or method of masterplanning.

The impetus for the review of NZS 4404:2004 came from requests for changes from:

(f) The New Zealand Transport Agency (NZTA);

(g) Local Government New Zealand (LGNZ);

(h) The Ministry for the Environment (MfE);

(i) Pipe manufacturers;

(j) Territorial authorities (TAs), and;

(k) A number of individual users of the Standard.

The Queenstown Lakes District Council (QLDC) under copyright licence has reproduced NZS 4404:2010 and Council amendments with further modifications to produce this document for its use as a land development and subdivision code of practice within this geographical area of jurisdiction.

The revision was sponsored by LGNZ, NZTA, and MfE.

Innovative subdivision has been discouraged to some extent under the 2004 version of NZS 4404. The objectives of the 2004 version were to permit alternative solutions. However, in practice, well designed solutions that were not in accordance with the acceptable solutions specified by the Standard often had difficulty gaining RMA consents. This led to delays and additional costs or a less desirable design being adopted.

The review committee therefore challenged itself to produce a new Standard that:

(l) Encourages sustainable and modern design;

(m) Provides some certainty for designers and LAs; and

(n) Prevents the outcomes that can arise when the sole focus is cost minimisation, and adherence to minimum standards.

The committee recognises that there are tensions between these sometimes conflicting objectives and has balanced those tensions when deciding between allowing flexibility and prescribing clear rules.

The committee would like to thank the many people who between them made more than 1,900 comments and suggestions for improvements. The submissions were overwhelmingly in support of the new direction of the Standard. Every single comment and suggestion was reviewed by committee members and many have found their way into the final document. It is a significantly better Standard because of those submissions. The committee would also like to thank all those organisations that have allowed their documents to be used in the Standard or as reference documents. The committee has tried not to 'reinvent the wheel' where existing documents provide the appropriate standards. This is why many other publications including Standards are referenced byNZS 4404:2010.

Finally, we all need to applaud and be grateful for the countless hours and effort committee members contributed to this review. The only payment is the satisfaction of a well-written Standard that enjoys good community support. It is a Standard that helps develop people-oriented communities with land development and subdivision infrastructure that has a long life, and the minimum environmental impact compatible with good urban design.

OUTCOME STATEMENT

NZS 4404:2010 provides local authorities, developers, and their professional advisors with standards for design and construction of land development and subdivision infrastructure. NZS 4404:2010 encourages sustainable development and modern design that emphasises liveability and environmental quality. It will also provide as much consistency as possible on land development and subdivision infrastructure while still allowing flexibility for local variations to suit local circumstances.

1 GENERAL REQUIREMENTS AND PROCEDURES

Subdivisions and developments shall also comply with all relevant policies or procedures adopted by the Council. Where ambiguities and inconsistencies exist between this code and any Policy or procedure adopted by the Council it is the developers responsibility to identify these and obtain guidance from the Council confirming which document should be followed.

Where community specific guidelines are available these shall be taken into consideration throughout the design and construction of subdivisions and development. Where community specific considerations cannot be met, written acceptance of an alternative method shall be obtained from the Council.

1.1 Scope

NZS 4404:2010 is recommended for adoption by local authorities (LAs). It is applicable to greenfield and infill development, as well as brownfield redevelopment projects. The Standard also serves as a basis for technical compliance for the subdivision and development of land where these activities are subject to the Resource Management Act. LAs may develop their own standards for land development or tailor outcomes sought to the particular needs of their local environments through their design guides, district plans, and codes of practice or development engineering manuals. However, it is recommended that NZS 4404 be adopted as the basis for these standards.

Section 1 of this Code of Practice concerns matters of general application and general requirements to be observed. Sections 2 to 8 of this Code of Practice provide good practice guidelines on particular types of infrastructure to be provided.

C1.1

NZS 4404:2010 *does not include a statement of all minimum requirements for land development and subdivision infrastructure. It is not an urban design guide. LAs may specify their own minimum requirements, citing* NZS 4404:2010*or their own bylaws or district plan as appropriate.*

NZS 4404:2010*does not deal with the processes of compliance with the requirements of a district plan for subdivision or development activities or obtaining a resource consent for such activities. For these purposes reference can be made to the Ministry for the Environment website, http://www.mfe.govt.nz, and the plans and* *policies of the relevant LA.*

1.2 Interpretation

1.2.1 General

1.2.1.1

The full titles of referenced documents cited in this Code of Practice are given in the list of referenced documents.

1.2.1.2

The word ‘shall’ refers to practices which are mandatory for compliance with the Code of Practice. The words ‘should’ or ‘may’ indicate a recommended practice.

1.2.1.3

Clauses prefixed by '*C*' and printed in italic type are intended as comments on the corresponding mandatory clauses. They are not to be taken as the only or complete interpretation of the corresponding clause. This Code of Practice can be complied with if the comment is ignored.

1.2.1.4

The terms 'informative' and 'normative' have been used in this Code of Practice to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance. Informative provisions do not form part of the mandatory requirements of this Code of Practice.

1.2.1.5

Schedules containing information to be provided in certificates or as-built plans are included at the end of sections to which they relate. Each schedule is copyright waived, meaning it may be photocopied for use in accordance with the Code of Practice.

1.2.2 Definitions

For the purpose of this Code of Practice, the following definitions shall apply:

Annual exceedance probability (AEP): The probability of exceedance of a given occurrence, generally a storm, in a period of 1 year (1% AEP is equivalent to a 1 in 100-year storm)

Carriageway: That part of a road consisting of the movement lane, sealed shoulder, and includes parking and loading areas when provided within the road

Corridor manager: Has the same meaning given to it by the proposed utilities access legislation

NOTE – In preparing NZS 4404:2010, the Committee made every effort to align it with the infrastructure legislation and the utilities access legislation still before Parliament at the time this Standard is published. Readers will need to satisfy themselves on the final form of the definitions of code (see section 8) and corridor manager once this utilities access legislation comes into effect.

Crime prevention through environmental design: Has a set of four principles: surveillance, access management, territorial reinforcement, and quality environments of the built environment. These CPTED principles lead to a reduction in the incidence and fear of crime as well as an improvement in the quality of life

Developer: An individual or organisation having the financial responsibility for the development project. Developer includes the owner

Developer's professional advisor	The person, appointed by the developer, who shall be responsible for: (a) The investigation, design and obtaining of approvals for construction; (b) Contract administration and supervision of construction; (c) Certification upon completion of construction
Drinking water	As defined in the Health (Drinking Water) Amendment Act
Dwelling unit	Any building or group of buildings, or part thereof used, or intended to be used principally for residential purposes and occupied, or intended to be occupied by not more than one household
Earthworks	Any alteration to the contours, including the excavation and backfilling or recompaction of existing natural ground and the stripping of vegetation and topsoil
Footpath	So much of any road or other area as is laid out or constructed by authority of the TA primarily for pedestrians; and may include the edging, kerbing, and channelling of the road
Freeboard	A provision for flood level design estimate imprecision, construction tolerances, and natural phenomena (such as waves, debris, aggradations, channel transition, and bend effects) not explicitly included in the calculations
Geo-professional	A chartered professional engineer (CPEng) or an engineering geologist with recognised qualifications and experience in geotechnical engineering, and experience related to land development
Ground	Describes the material in the vicinity of the surface of the earth whether soil or rock
Independent qualified person (IQP)	A specialist approved by the TA and having the appropriate skills and qualification to carry out specific procedures
Local authority	As defined in the Local Government Act 2002, and includes territorial authorities and regional councils
Low impact design	An approach to land development and stormwater management that recognises the value of natural systems in order to mitigate environmental impacts and enhance local amenity and ecological values
Movement lane	That part of the formed and sealed road that serves the link function in a road. It may have a shared use for other activities such as walking, cycling, parking, and play

Network utility operator	Has the same meaning given to it by section (s.) 166 of the Resource Management Act

Owner	In relation to any land or interest in land, includes an owner of the land, whether beneficially or as trustee, and their agent or attorney, and a mortgagee acting in exercise of power of sale; and also includes the Crown, the Public Trustee, and any person, TA, board, or other body or authority however designated, constituted, or appointed, having power to dispose of the land or interest in land by way of sale
Potable water	As defined in the Health (Drinking Water) Amendment Act
Primary flow	The estimated surface water run-off specified to be managed by the primary stormwater system. This flow may be piped or contained within relatively narrow confines under public control by reserve or easement
Private road	Any roadway, place, or arcade laid out within a district on private land by the owner of that land intended for the use of the public generally and has the same meaning given to it by s. 315 of the Local Government Act 1974
Private way	Any way or passage over private land within a district, the right to use which is confined or intended to be confined to certain persons or classes of persons, and which is not thrown open or intended to be open to the use of the public generally and includes any shared access or right of way and has the same meaning given to it by s. 315 of the Local Government Act 1974
Receiving water	The water body that receives the discharge from the stormwater conveyance system and is usually a watercourse, stream, river, pond, lake, or the sea
Review and Acceptance	The purpose of QLDC completing a design/construction review and accepting the design/construction is to ensure the developer has provided sufficient supporting documentation. Acceptance or approval of the design and or construction does not transfer any liability to the Council and it has been provided on the basis that the developer has confirmed all elements of this Code of Practice have been complied with unless stated otherwise in the acceptance/approval letter.
Road	Has the same meaning given to it by s. 315 of the Local Government Act 1974
Secondary flow	The estimated surface water run-off in excess of the primary flow. In most cases this flow will be managed in an overland flowpath or ponding area that is protected by public ownership or easement
Stormwater	Rainwater that does not naturally percolate into the ground

	or evaporate, but flows via overland flow, interflow, channels, or pipes into a defined surface water channel, open watercourse, or a constructed infiltration facility
Street	Has the same meaning as 'road' as defined by s. 315 of the Local Government Act 1974
Surface water run-off	All naturally occurring water, other than subsurface water, which results from rainfall on the site or water flowing onto the site, including that flowing from a drain, stream, or river
Survey plan	A survey plan under s. 2 of the Resource Management Act
Swale	A constructed watercourse shaped or graded in earth materials and stabilised with site-suitable vegetation or rocks, for the safe conveyance and water-quality improvement of stormwater run-off
Target operating speed	The desired maximum speed for motor vehicles identified by the designer to suit the land use context and road classification. This speed can be managed by physical and psychological devices such as narrowed movement lanes, reduced forward visibility, parking, slow points, build outs, leg lengths, chicanes, planting, landscaping, street furniture, and art works
Territorial authority	A territorial authority (TA) defined in the Local Government Act 2002
Wāhi tapu	Means a place sacred to Māori in the traditional, spiritual, religious, ritual, or mythological sense
Wastewater	Water that has been used and contains unwanted dissolved or suspended substances from communities, including homes, businesses, and industries

1.2.3 Abbreviations

The following abbreviations are used in this Code of Practice:

ABS	acrylonitrile butadiene styrene
AEP	annual exceedance probability
AV	air valve
°C	degrees Celsius
CBD	central business district
CBR	California bearing ratio
CCTV	closed circuit television

CLS (SCL)	concrete lined steel (steel concrete lined)
CPTED	Crime prevention through environmental design
Code of Practice	Queenstown Lakes District Council Land Development and Subdivision Code of Practice
DI	ductile iron
DN	nominal diameter under the pipe manufacturing standard
du	dwelling unit
ESA	equivalent standard axle
FAC	free available chlorine
FAR	floor-to-area ratio
FL	flange
FSL	finished surface level
GL	ground level
g/m^3	grams per cubic metre
GRP	glass reinforced plastic
H	head (in metres)
h	hour
ha	hectare
HDD	horizontal directional drilling
IQP	independent qualified person
km	kilometre
km/h	kilometres per hour
kPa	kilopascal
L	litre(s)
LA	local authority
LID	low impact design
m	metre
MDD	maximum dry density
MH	manhole or maintenance hole
min	minute(s)
MPa	megapascal
MS	maintenance shaft
m/s	metres per second
m^3/s	cubic metres per second
mm	millimetres
NAASRA	National Association of Australian State Road Authorities
NES	National Environmental Standard
NIWA	National Institute of Water and Atmospheric Research

NPS	National Policy Statement
NZBC	New Zealand Building Code
NZHPT	New Zealand Historic Places Trust
NZTA	New Zealand Transport Agency
OSH	Occupational Safety and Health
p	person
PE	polyethylene
PE 80B	polyethylene with minimum required strength (MRS) of 8 MPa as defined in AS/NZS 4130 and AS/NZS 4131
PE 100	polyethylene with MRS of 10 MPa as defined in AS/NZS 4130 and AS/NZS 4131
PF	peaking factor
PIPA	Plastics Industry Pipe Association of Australia Ltd
PN	nominal pressure class (maximum rated operating pressure)
PP	polypropylene
PRV	pressure reducing valve
PVC	polyvinyl chloride
PVC-U	unplasticised polyvinyl chloride
PVC-M	modified polyvinyl chloride
PVC-O	orientated polyvinyl chloride
RMA	Resource Management Act
RRJ	rubber ring joint
s.	section
Soc	socket
STP	specified test pressure
TA	territorial authority
TMS	terminal maintenance shaft
UV	ultraviolet
VC	vitrified clay
vpd	vehicles per day

1.3 Context

This Code of Practice is relevant to Acts such at the Resource Management Act, Building Act, Historic Places Act and other legislation. The purpose of NZS 4404:2010 is to provide standards for the implementation of well designed land development and subdivision infrastructure projects that have obtained the necessary resource consents under the RMA, and comply with other legislation. LAs will be able to invoke compliance with NZS 4404:2010 and their own local additions and variations, to ensure that the sustainability, urban design, and environmental impact objectives of land development and subdivision projects are carried through to completion. The interrelationship between this Code of Practice and these Acts is outlined below.

The Code of Practice also provides best practice land development and subdivision infrastructure techniques in low impact design, climate change, and urban design.

1.3.1 Resource Management Act

The Resource Management Act 1991 (RMA) is the principal statute under which the development and subdivision of land is controlled.

Regional and district plans prepared under the RMA are the key resource management instruments that LAs implement to achieve sustainable management of natural and physical resources, which is the overarching purpose of the RMA.

This Code of Practice does not have a binding effect unless incorporated into a regional/district plan or bylaw. If the Code of Practice is not referred to in the plan or any bylaw, the Code of Practice can still serve as a technical compliance manual to assist in guiding decision-making and forming conditions of resource consent.

A national policy statement (NPS) and national environmental standard (NES) may also apply to a proposed development in addition to regional and district planning documents. However NPS and NES only apply once they are finalised and gazetted whereas regional and district plan provisions may apply to consent applications as soon as they are notified.

C1.3.1

Over time, central government may develop other NPS and NES which may affect decision-making by LAs on land development and subdivision, including national policy on freshwater management, sea level rise, and flood risk. The Ministry for the Environment's website should be referred to for any relevant NPS and NES.

The protection of historic heritage from inappropriate subdivision, use, and development is a matter of national importance under s. 6(f) of the RMA. The RMA's definition of historic heritage includes: historic sites, structures, places, and areas; archaeological sites; sites of significance to Māori including wāhi tapu; and surroundings associated with the natural and physical resources. Therefore regional/district plans should be reviewed to ascertain whether any development proposal affects historic heritage. Most plans have a historic heritage schedule, which lists the item protected, its location, and its sensitivity. A precautionary approach should be taken prior to any land development and subdivision infrastructure affecting historic heritage, with the LA consulted at the earliest stage (see 1.3.2).

Where applications for resource consents may affects sites of significance to Māori, consultation with the appropriate tangata whenua groups should occur prior to finalising plans or submitting applications for resource consent in order to give effect to Part II of the RMA.

1.3.2 Historic Places Act

In addition to the RMA, the Historic Places Act regulates the modification of archaeological sites on all land and provides for substantial penalties for unauthorised destruction, damage, or modification of these sites.

The Act makes it unlawful for any person to destroy, damage, or modify the whole or any part of an archaeological site registered with the New Zealand Historic Places Trust (NZHPT), without the prior authority of the NZHPT. This is the case regardless of whether:

(a) The site is registered or recorded by the council in planning documents;

(b) The land on which the site is located is designated;

(c) The activity is permitted under the district or regional plan; or

(d) A resource or building consent has been granted.

Therefore approval from the NZHPT is required if a site registered with the NZHPT is affected, in addition to any council approval that may be required.

Furthermore, if the site is known to be associated with pre-1900 human activity, or there is reasonable cause to suspect such an association, the developer should consult with the NZHPT prior to undertaking any earthworks or ground disturbance.

1.3.3 Building Act

The Building Act provides a national framework for building control to ensure that buildings are safe and sanitary and have suitable means of escape from fire. The Building Regulations made under the Act provide the mandatory requirements for building control in the form of the New Zealand Building Code. The Building Code contains the objective, functional requirements, and performance criteria that building works shall achieve.

Where the development of land and subdivision infrastructure involves the creation of structures with associated site works, including specific aspects of stormwater management and the interaction of buildings, fences, and walls with stormwater flows, the requirements of the Building Act shall be observed. Nothing in this Code of Practice shall detract from the requirements of the Building Act or the Building Code.

> ***C1.3.3***
>
> *Systems owned or operated by a network utility operator for the purpose of reticulation are not included in the definition of building under the Building Act.*

1.3.4 Other legislation

The Reserves Act, Conservation Act, and other Acts may also require consideration when undertaking land development and subdivision infrastructure. Covenants (a legal restriction or agreement recorded on the title of a property that is a matter of private contract) may also require consideration. For example, a Queen Elizabeth II Act Open Space Covenant is a legally binding protection document agreed between a landowner and the QEII National Trust.

1.4 Low impact design

Low impact design (LID) is both a design approach and a range of structural techniques that can be applied to urban development and stormwater management. As a design approach, LID provides an opportunity to identify and recognise natural features and integrate these into the design of development layouts in order to minimise environmental impacts or enhance natural features. The integration of natural processes in the design stage of a development can result in more attractive, multifunctional landscapes with greater social, environmental, cultural, and transport outcomes.

Low impact design solutions that use natural processes and add value to urban environments are the preferred approach.

1.5 Climate change

Climate change is likely to increase the magnitude of some hazards, therefore it is important to incorporate risk management in the design of infrastructure supporting new developments to maintain the same level of service throughout the design lifetime. The design of infrastructure for land development and subdivision needs to provide for the impact of sea level rise and the increased frequency of extreme weather events.

> ***C1.5***
>
> *Amendments to the Resource Management Act, the Local Government Act 2002, and the Building Act require LAs to have particular regard to the effects of climate change when making decisions under these Acts.*
>
> *In coastal areas, the proposed 'New Zealand coastal policy statement' (policy 52)*

requires LAs to consider the location of any new subdivisions in the context of avoiding or reducing potential coastal hazards.

The government is considering the development of a number of other national policy instruments which may affect decision-making by local authorities, including a 'National environmental standard on sea level rise' and a 'National policy statement on flood risk'. These would not take effect until they are gazetted.

1.6 Urban design protocol

The *New Zealand urban design protocol* seeks to ensure that the design of buildings, places, spaces, and networks that make up our towns and cities, work for all of us, both now and in the future. NZS 4404 includes recommended best practices that support urban design protocol initiatives. The *New Zealand urban design protocol* identifies seven essential design qualities for good urban design:

(a) Context: seeing that buildings, places, and spaces are part of the whole town or city;

(b) Character: reflecting and enhancing the distinctive character, heritage, and identity of our urban environment;

(c) Choice: ensuring diversity and choice for people;

(d) Connections: enhancing how different networks link together for people;

(e) Creativity: encouraging innovative and imaginative solutions;

(f) Custodianship: ensuring design is environmentally sustainable, safe, and healthy;

(g) Collaboration: communicating and sharing knowledge across sectors, professions, and with communities.

The *New Zealand urban design protocol* has been the primary influence on the urban layouts that are encouraged in this Code of Practice.

1.7 Requirements for design and construction

1.7.1 Investigation and design

All investigation, calculations, design, supervision, and certification of the infrastructure outlined in this Code of Practice shall be carried out by or under the control of persons who:

(a) Are experienced in the respective fields;

(b) Hold full membership in the respective professional bodies;

(c) Have appropriate professional indemnity insurance and public liability insurance.

The provisions of this Code of Practice do not reduce the responsibility of those professionals to exercise their judgement and devise appropriate solutions for the particular circumstances of each development.

1.7.2 Construction

All construction carried out in any development shall be done by persons who:

(a) Have the appropriate experience in the relevant areas;

(b) Have the appropriate equipment;

(c) Have the appropriate public liability insurance;

(d) Meet the requirements of the Health and Safety in Employment Act.

1.8 Acceptance of design and construction

1.8.1 Documents to be submitted for design review and acceptance

1.8.1.1

Prior to, or as a condition of, granting a resource consent for subdivision or development of land, or as otherwise required by a district plan, or as otherwise considered necessary by QLDC when considering applications to construct infrastructure, QLDC shall require documents to be submitted including the following:

(a) Engineering review and acceptance application form and deposit
(b) Design, construction, operation and maintenance documentation including drawings, specifications and calculations for the following:
    (i) Earthworks and geotechnical requirements
    (ii) Roading and site access including a design and access statement (see 3.2.6 of NZS4404:2010) and a road safety audit (see 3.2.7 of NZS4404:2010)
    (iii) Stormwater (including overland flow paths and a catchment wide assessment if required by the Council)
    (iv) Wastewater
    (v) Water supply
    (vi) Landscape
    (vii) Network Utility Services
(c) A geo-professional's report on the suitability of the land for subdivision or development if required by the Council
(d) Other reports as considered necessary by QLDC in the circumstances of the proposed infrastructure in order to meet the requirements of this code
(e) An access and maintenance strategy shall be provided for all non-standard assets to be vested to QLDC. Unless otherwise agreed in writing with QLDC, or as required by relevant legislation, the strategy document shall be prepared on the basis that no specialist training or equipment shall be required to access the vested asset.
(f) A design certificate, for each design discipline, in the form of the certificate in schedule 1A of NZS 4404:2010. Each certificate shall include a schedule of documents to which it applies. The limit of damages shall be agreed with the Council.

All documents other than signed certificates shall be submitted electronically as an enabled PDF (searchable PDF, not a scanned copy). Colour hard copies of all documents shall be provided at any time if requested by QLDC.
All documents shall demonstrate that they have passed through an internal Quality Management System. As a minimum they shall clearly show that they have been checked and approved by a suitable person (refer to section 1.7 for the requirements of a suitable person) different from the document author.

1.8.2 Drawings

1.8.2.1 General

Design drawings shall be prepared in accordance with the LA's practices. Except where otherwise notified, the requirements are as set out in this section and in sections

2 to 8 of this Code of Practice. Drawings shall be accepted by the LA. All drawings shall be provided in a form required by the LA.

Drawings shall be to adequate detail to clearly illustrate the proposals and enable assessment of compliance with this Code of Practice and enable accurate construction.

1.8.2.2 Composition of drawings

Design drawings generally include the following:

(a) A locality plan giving the overall layout and location;

(b) Detailed plans, longitudinal sections, cross sections, and diagrams of the proposed developments;

(c) Special details where the standard drawings are not sufficient;

(d) A north point and level datum, the scale or scales used, the date of preparation and the date of any amendments, the designer's name and contact details, and a unique number or identifier.

1.8.2.3 Scale

The scale for plans is generally 1:500 but other accepted scales may be used to suit the level of detail on the plans. Special details shall be to scales appropriate for clarity. Individual LAs may require other specific scales to be used.

1.8.2.4 Content of drawings

The following information when relevant shall be shown on the design drawings:

(a) The extent of the construction showing existing and proposed roads, and the relationship with adjacent construction, services, or property;

(b) Significant existing vegetation to be removed and any special or protected trees, areas of heritage significance, and existing water bodies that may be affected by the construction;

(c) The extent of earthworks, including earthworks on proposed reserves, existing and proposed contours, areas of cut and fill, batter slopes, subsoil drainage, and silt control measures both temporary and permanent;

(d) The design of proposed roads (and their connections with existing roads), including longitudinal and cross section plans, horizontal and vertical geometry and levels, typical cross sections, details of proposed pavement surface, kerbing, swales, berms, footpaths, cycle paths, tree planting, road marking and signals, and all other proposed road furniture;

(e) The horizontal and vertical location and alignment, lengths, sizes, materials, minimum cover, position relative to other services of all proposed water, wastewater, and stormwater systems and service connections, valves, hydrants, manholes, bends, tees, meters and backflow devices, and services that may be reconnected or plugged, and any proposed overland stormwater flow path;

(f) Details and location of mechanically restrained portions of pipelines, pipeline bridges, pumping stations, reservoirs, intake and outlet structures and the location of surface obstructions, hazards, or other features that may be affected by the construction;

(g) For water mains, the nominal static pressure head at the point of connection and at the lowest point; design pressure and maximum design pressure;

(h) Details and location of existing and proposed telecommunications, electricity and gas supply, and street lighting layout, including proposed underground and above ground junction boxes, transformers and similar equipment. This information is typically provided by the service authorities once other design drawings are finalised and approved;

(i) Details of proposed landscaping of roads and allotments, and details of proposed reserve development including earthworks, hydrological features, walkways and accessways, landscaping features, landscaping structures, tree planting, revegetation, hard and soft surface treatment, park and road furniture, and playground equipment.

1.8.2.5 Recording of infrastructure – As-built information

The LA may require the design drawings to be in a certain format, suitable for later addition of as-built information and inclusion in the LA asset map base. In particular, electronic plans may be required.

1.8.3 Design basis for documents submitted for review and acceptance

1.8.3.1 Standard design basis

Proposals submitted on a standard design basis shall conform to this Code of Practice.

1.8.3.2 Alternative design basis

Proposals submitted on an alternative design basis may differ from this Code of Practice and shall apply specifically to a particular proposal. LA review and acceptance of an alternative design does not confer approval in general by the LA to any design criteria, construction technique or material forming part of the alternative design.

An explanation of the design basis or construction method is to be submitted, for review and acceptance in principle. It will be considered on its merits and should be approved provided that the design results in infrastructural development equivalent or superior in performance to that complying with this Code of Practice.

Alternative designs provide flexibility to meet the circumstances and requirements peculiar to the site, or as a means of encouraging innovative design, or to meet the principle of life-cycle costing.

1.8.3.3 Life-cycle costing

Life-cycle costing may be used to consider options within a proposal or a proposal as a whole. In undertaking a life-cycle costing, consideration shall be given to the initial costs borne by the developer and the maintenance and replacement costs borne by the future owners or the LA. A reasonable balance shall be maintained between these short-term and long-term costs.

1.8.4 Review and acceptance of design

1.8.4.1

When it is satisfied that the design meets the requirements of this Code of Practice, or the LA's own provisions, or in the case of an alternative design, that the design satisfies the requirements of 1.8.3.2, the LA shall notify the owner that the design has been approved and endorse the plans, specifications, and other documents accordingly. For the purpose of this review and acceptance the LA may require the owner to make amendments to any plans, specifications, and other documentation and to submit further or other reports. In considering project design and giving its review and acceptance, the LA shall act without undue delay.

1.8.4.2 Review and acceptance before commencing construction

Construction shall not commence on site unless and until:

(a) Resource consents have been issued, except when no such consents are required; and

(b) The LA(s) have approved any other consents and the drawings, specifications, and calculations for the specific infrastructure that is required in accordance with 1.8.4.1.

> ***C1.8.4.2***
>
> *S. 116 of the Resource Management Act sets out when a resource consent commences. Generally this will be when any appeals against the grant of the consent have been disposed of. Where any appeals are unresolved, approval to commence work will need to be obtained from the Environment Court.*

1.8.5 Notification of contracts and phases of construction

1.8.5.1

The developer shall notify the LA, in writing, of the names and addresses of contractors to whom it is proposed to award the contracts, and the nature of the construction in each case.

1.8.5.2

Unless the LA requires otherwise, the developer shall notify the LA when the following phases of construction are reached and such other phases as the LA may determine to enable inspection to be carried out:

(a) Commencement of construction;

(b) Prior to concrete construction;

(c) Prepared earthworks and subsoil drainage prior to filling;

(d) Completed earthworks and prepared subgrade;

(e) Water, wastewater, and stormwater reticulation prior to backfilling;

(f) Water and wastewater reticulation during pressure testing;

(g) Finished basecourse before the commencement of road sealing;

(h) Disinfection of water mains.

At least 24-hours notice shall be given by the developer. Inspection shall be carried out within 24 hours of notification if possible. Further construction phases shall not proceed until inspection has been made.

> ***C1.8.5.2***
>
> *LAs may require the appointment of a 'developer's professional advisor' or 'independent qualified person (IQP)' in which case this requirement will be performed by that person.*

1.8.6 Supervision of construction

The level of supervision undertaken in connection with any construction shall be agreed between the LA and the developer, or, if appointed, the developer's professional advisor or the IQP as the case may be, and shall be appropriate to the circumstances considering the size and importance of the project, the complexity of the construction, and the experience and demonstrated skill in quality management of the person undertaking the construction.

The LA may require completion certification for construction and supervision be submitted to it on completion. Such certification may be required from the contractors undertaking the construction, or the developer, or the developer's professional advisor (if any). The certificates shall be in the form given in Schedules 1B and 1C.

> ***C1.8.6***
>
> *An appropriate level of supervision can be selected by reference to the Construction Monitoring Services information published by the Institution of Professional Engineers*

of New Zealand (IPENZ) and the Association of Consulting Engineers New Zealand (ACENZ).

1.8.7 Connecting to existing services

1.8.7.1

Connection of water, wastewater, stormwater, and other services to existing systems will normally be carried out by the appropriate network utility operator at the cost of the developer, except that at the discretion of the network utility operator connections may be made by the owner, or contractor employed by the owner, if appropriately qualified and under the network utility operator's supervision.

1.8.7.2

The developer shall give the network utility operator 5 working days notice of intention to connect to existing services. Where required, new services shall be tested and approved by the network utility operator prior to connection.

1.8.8 Testing

Any infrastructure required to be tested by the developer shall be pre-tested and proved satisfactory by the developer before test by the network utility operator is requested.

Prior to requesting inspection by QLDC the developer shall submit copies of test certificates/reports confirming that the infrastructure has been inspected and proved satisfactory.

1.8.9 Maintenance

The developer shall maintain the infrastructure until it is formally taken over by the TA or to a date specified in a bond or consent condition for completion of uncompleted infrastructure. The developer shall not be responsible for damage caused by other activities such as building construction or for fair wear and tear or vandalism caused by public use of the roads that have been taken over by the TA or network authority.

Extended maintenance periods may be imposed if adequate testing and supervision cannot be demonstrated.

1.8.10 Completion documentation

On completion of all subdivision and land development infrastructure, the developer shall provide the LA with the following:

(a) The geotechnical reports and as-built plans required by 2.6 of this Code of Practice;

(b) As-built plans of all infrastructure showing the information set out in Schedule 1D. As-Built plans shall be provided as electronic data and shall be in a format that meets QLDC's GIS and As-built standard;

(c) Evidence that all testing required by this Code of Practice has been carried out and that the test results comply with the requirements of this Code of Practice;

(d) Evidence that reticulation and plant to be taken over by network utility operators have been installed to their standards and will be taken over, operated and maintained by the network utility operator concerned;

(e) Completion certificates as per Schedules 1B and 1C;

(f) Certification by a suitably qualified person where they have recommended a specific design and construction has been undertaken in accordance with that recommendation. The certification shall state that the suitably qualified person supervised the construction and it has been completed in accordance with the recommended design principles;

(g) Other documentation required by the TA including, but not limited to, operation and maintenance manuals, and warranties for new facilities involving electrical or mechanical plant and asset valuations for all infrastructures to be taken over by the TA.

(h) A schedule of all assets to be taken over (vested) by Council. The schedule shall utilise QLDC's Asset Register Templates.

1.8.11 Acceptance of uncompleted work

Where in the opinion of the TA it is assessed as reasonable, and unlikely to materially affect the safe operation of public assets and expectations and interests of the public and directly affected private parties, the TA may approve the deferral of completion of an element of a consented and approved work, subject to satisfactory bonds being arranged.

1.9 Bonds and charges

1.9.1 Uncompleted works

1.9.1.1

Bonds to cover uncompleted works, especially where a subdivision or development has been substantially completed, are recognised as an acceptable procedure and should be permitted at the discretion of the TA. Acceptance of a bond for uncompleted works shall not be unreasonably withheld.

1.9.1.2

Bonds shall be secured by an appropriate guarantee or shall be in cash and lodged with the TA. Where necessary bonds shall be executed and registered.

1.9.1.3

The amount of the bond shall be the estimated value of the uncompleted work plus a margin to cover additional costs estimated to be incurred by the TA in the event of default.

The bond amount shall be a minimum of 1.5 times the higher amount of two quotes approved by QLDC.

1.10 Defect Liability Bond

Prior to the issue of a 224(c) certificate a defects liability bond shall be entered into by the developer for all assets to be vested to the Council. The bond shall be valued at 5% of the construction costs for all assets to be vested. The bond shall be for a minimum of 12 months commencing on the date of 224c issue and will only be released following a site inspection by the Developer and the Council. The bond shall be secured by an appropriate guarantee or shall be in cash and lodged with the Council. Alternative arrangements may be agreed with the Council

C1.9.1

A satisfactory system of bonding uncompleted works is needed to overcome delays in obtaining the deposit of land transfer plans for subdivision. A major factor can be the practical difficulties of fully completing the construction of a subdivision caused by inclement weather, shortages of machinery, materials, and labour and the difficulty of coordinating the many aspects required to achieve full completion of a substantially completed subdivision.

The authority to require bonds is given in s. 108(2)(b) and s. 108A of the Resource Management Act, and s. 109 of that Act deems bonds and covenants to be instruments registerable under the Land Transfer Act, running with the land and binding subsequent owners. Section 109 of the Resource Management Act also gives the TA the power to enter land and complete the work. Additional powers are given by s. 223 of the Resource Management Act to allow the deposit of a survey plan notwithstanding uncompleted work.

SCHEDULE 1A

DESIGN CERTIFICATE – LAND DEVELOPMENT/SUBDIVISION

ISSUED BY:………………………………………………………………………………………………

(Approved certifier firm/suitably qualified design professional)

TO: ……………………………………………………………………………..…………………

(Developer/owner)

TO BE SUPPLIED TO:……………………………………………………………..…………………

(Territorial authority)

FOR: …………………………………………………………………..………………………………

(Description of land development/subdivision)

AT:………………………………………………………………………………………………………

………………………………………………………………………………………..…………………

(Address)

……………………………………. has been engaged by ....……………….

(Consultant/designer) *(Developer/owner)*

to provide……………………………………. services for the land development and/or subdivision described above.

I …………………………………….have the qualifications and experience relevant to this project as set out herein and have designed the land development/subdivision and confirm that the design is to current engineering practice, and that I believe on reasonable grounds that it satisfies all relevant resource consent conditions, all relevant ……………………………………………………(insert name of authority) requirements and applicable codes and standards.

I / My practice holds professional indemnity insurance to the amount of $……………….and includes run-off cover.

…………………………………………… Date ……………………………………………………..

(Signature of approved certifier on behalf of the approved certifier firm)

……

(Name, title, and professional qualifications)

NOTE – This statement shall only be relied upon by the territorial authority named above. Liability under this statement accrues to the approved certifier firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the territorial authority on this land development/subdivision, whether in contract, tort, or otherwise (including negligence), is limited to the sum of $............................ (insert)

Copyright waived

SCHEDULE 1B

CONTRACTOR'S CERTIFICATE UPON COMPLETION OF LAND DEVELOPMENT/SUBDIVISION

ISSUED BY:……………………………………………………………………………………………………
(Contractor)

TO: ………………………………………………………………………………..………………………
(Principal)

TO BE SUPPLIED TO:……………………………………………………………..………………………
(Territorial authority)

FOR: ………………………………………………………………….……………………………...…
(Description of land development/subdivision)

AT:……

………………………………………………………………………………….………………………
(Address)

………………………………… has contracted to ....…………………………..
(Contractor) *(Principal)*

to carry out and complete certain land development and/or subdivision construction in accordance with a contract, titled Contract No. ………… for ………………………………(‘the contract’).

I …………………………… a duly authorised representative of …………………………………………
(Duly authorised agent) *(Contractor)*

hereby certify that ……………………………………………… has carried out and completed
(Contractor)

the construction, other than those outstanding works listed below, in accordance with the contract and in accordance with approved engineering drawings and specifications.

………………………………………………… Date …………………………………………………

(Signature of authorised agent on behalf of)

…………………………………………………
(Contractor)

………………………………………………… ……………………………………………………
(Address)

Outstanding works

…………………………………………………………………………..……………………………
…………………………………………………………………………..……………………………
…………………………………………………………………………..……………………………

SCHEDULE 1C

CERTIFICATION UPON COMPLETION OF LAND DEVELOPMENT/SUBDIVISION

ISSUED BY:………………………………………………………………………………………………

(Approved certifier firm)

TO: ……………………………………………………………………………………..…………………

(Developer/owner)

TO BE SUPPLIED TO:………………………………………………………………….…………………

(Territorial authority)

FOR: ………………………………………………………………….…………………………………

(Description of land development/subdivision)

AT:………

……………………………………………………………………………………….…………………

(Address)

………………………………… has been engaged by ....………………

(Consultant/designer) *(Developer/owner)*

to provide construction observation review and certification services for the above subdivision which is described in the specification and shown on the drawings numbered

……………......................................…approved by………..…………

(Territorial authority)

I have sighted the ……………………………………………… consent and conditions of subdivision

(Territorial authority)

and the approved specification and drawings.

On the basis of periodic reviews of the construction and information supplied by the contractor in the course of the construction, I believe on reasonable grounds that the infrastructure other than those outstanding works listed below, is complete and has been constructed in accordance with:

(a) The approved engineering drawings and specifications and any approved amendments;

(b) The Council's Engineering Standards; and

(c) The manufacturer's instructions

....…… Date ………………………………………

(Signature of approved certifier on behalf of the approved certifier firm)

....

(Name, title, and professional qualifications)

NOTE – This statement shall only be relied upon by the territorial authority named above. Liability under this statement accrues to the approved certifier firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the territorial authority in relation to this land development/ subdivision, whether in contract, tort, or otherwise (including negligence), is limited to the sum of $......................... (insert).

Outstanding works

…………………………………………………………………………………..……………………………

Copyright waived

SCHEDULE 1D

AS-BUILT PLANS

Information given on as-built drawings, whether submitted electronically or as paper plans, shall include but shall not be limited to:

(a) Stormwater and wastewater reticulation – including the coordinated positions of manholes, manhole inverts, inverts of pipes and lid levels, measurements to house connections, and laterals and their length and position. Positions of connections and laterals shall be both coordinated and referenced to adjacent manhole lids and boundary pegs. All levels shall be in terms of datum approved by the TA;

(b) Stormwater management devices – as-built plans for low impact stormwater management devices and non-reticulated components;

(c) Flood and secondary flow information, flood water levels and the extent of any overland secondary flows shall be shown where these have been obtained or derived during the design;

(d) Water reticulation – including the position of mains, location of hydrants, valves, tees, reducers, connections, tobies, water meters, and specials. All features shall be accurately dimensioned, coordinated, and referenced so that they can be accurately relocated in the field;

(e) Ducts – measurements to ducts installed by the developer for utilities;

(f) Labelling of pipes and ducts to cover diameter, pipe material and class, year laid, jointing type;

(g) Road names where available – as approved by the TA;

(h) Coordinates and levels of all utility surface features to be taken over by the TA, including tobies, and water meters;

(i) The coordinates of at least two points on each plan in terms of an appropriate geodetic or cadastral datum and the origin of the plan level datum;

(j) Geotechnical completion report and as-built drawings as detailed in 2.6.1 and 2.6.2 of NZS 4404:2010. As-built surface contours covering all areas of disturbed and cut/fill ground;

(k) Road construction, including location, structural details, and details of road marking, signals, lighting, and signs, landscape features, seating, and other amenities and features;

(l) Road pavement and surfacing information;

(m) Landscape features, seating, and other amenities and features.

2 EARTHWORKS AND GEOTECHNICAL REQUIREMENTS

Where community specific guidelines are available these shall be taken into consideration throughout the design and construction of subdivisions and development. Where community specific considerations cannot be met, written acceptance of an alternative method shall be obtained from the Council.

2.1 Scope

This section sets out requirements for the assessment of land stability and the design and control of earthworks to ensure a suitable platform for the construction of buildings, roads, and other structures. A low impact design approach is preferred. Geotechnical assessment shall be undertaken by a geo-professional defined in 1.2.2 of this Code of Practice where:

(a) The assessment of land stability requires specialist expertise;

(b) The construction of earthworks associated with any development requires initial planning and design to ensure that banks and batters remain stable and that fill material is placed in such a way that it remains stable and can support the future loads imposed on it;

(c) There is historical fill which has not been undertaken in accordance with any Standard or where natural slopes, banks, or batters are involved;

(d) The assessment of ground for the foundations of buildings, roads, services, and other infrastructure requires specialist expertise as weak ground may require special design;

(e) The wide range of soil types, physical conditions, and environmental factors applying in different areas make it difficult to specify precise or prescriptive requirements for land stability assessment or earthworks.

In setting design, construction requirements, or development limitations the designer shall take account of all relevant standards and TA requirements.

> ***C2.1***
>
> *NZS 4431 is applicable to the construction of earth fills for residential development including residential roading.*

2.2 General

2.2.1 Objective

The objective of this section is to set out some, but not necessarily all of the matters which need to be considered in planning and constructing a land development project. The aim is to provide information for professionals involved in designing and constructing a land development project and to require geotechnical expertise in projects where land stability could be an issue or where earthworks other than of a minor nature will occur.

The geo-professional needs to be involved in the choice of final land form. This decision depends on many factors which may be specific to the development. These include the relationship with surrounding landscapes, the size of the development, the proposed and existing roading patterns, the preservation of natural features, wāhi tapu, and other historic and archaeological sites, the land stability and underlying structural geology, the function and purpose of the development and the potential for flooding, and erosion and other natural hazards and events including earthquakes. The aim is to also give guidance on the identification of and assessment of the order of importance of the above factors which will vary from project to project.

A geo-professional shall meet the requirements of section 1.1.7 of QLDC's Land Development and Subdivision Code Part 1

And

Modifications to the existing natural environment are to be minimised or avoided in order to preserve the existing landscape and habitat features as far as is practicable;

The land is to be stable at all times

2.2.2 Referenced documents

A selection of useful guidance material on geotechnical and geomechanical issues in land development is set out in Referenced Documents. Related Documents lists additional material that may be useful.

2.2.3 Local authorities' requirements

The TA may require an assessment of land stability to meet the provisions of the Resource Management Act and Building Act. The TA requires and relies on the assessment made by the geo-professional.

Special requirements apply when land is subject to erosion, avulsion, alluvium, falling debris, subsidence, slippage, rotation, creep, or inundation from any source. In such situations reference needs to be made to s. 106 of the Resource Management Act and, for subsequent building work, s. 71 of the Building Act.

Advice should be sought from the regional council for earthworks and consent requirements.

The methods used and investigations undertaken are defined by the TA and the geo-professional.

This Code of Practice does not set those requirements or set standards for assessing geotechnical risk.

2.2.4 Geotechnical requirements

Where any proposed development involves the assessment of slope stability or the detailed evaluation of the suitability of natural ground for the foundations of buildings, roading, and other structures, or the carrying out of bulk earthworks, then a geo-professional shall be appointed by the developer to carry out the following functions:

(a) Check regional and district plans, records, and requirements prior to commencement of geotechnical assessment;

(b) Prior to the detailed planning of any development, to undertake a site inspection and such investigations of subsurface conditions as may be required, and to identify geotechnical hazards affecting the land, including any special conditions that may affect the design of any pipelines, underground structures, or other utility services;

(c) Before construction commences, to review the drawings and specifications defining any earthworks or other construction and to submit a written report to the TA on the foundation and stability aspects of the project;

(d) Before and during construction, to determine the extent of further geo-professional services required (including geological investigation);

(e) Any work necessary to manage the risk of geotechnical instability during the construction process;

(f) Before and during construction, to determine the methods, location, and frequency of construction control tests to be carried out, determine the reliability of the testing, and to evaluate the significance of test results and field inspection reports in assessing the quality of the finished work;

(g) During construction, to undertake regular inspection consistent with the extent and geotechnical issues associated with the project;

(h) On completion, to submit a written report to the TA attesting to the compliance of the earthworks with the specifications and to the suitability of the development for its proposed use including natural ground within the development area. Where NZS 4431 is applicable, the reporting requirements of that Standard shall be used as a minimum requirement.

2.3 Design

2.3.1 Design factors

The design process shall include, but not be limited to:

(a) Preliminary site evaluation;

(b) Identification of special features to be retained/protected;

(c) Low impact design considerations;

(d) Selection of the choice of landform;

(e) Stability assessment;

(f) Assessment of special soil types where applicable;

(g) Setting of compaction standards for fill material;

(h) Erosion, sediment, and dust control;

(i) Seismic considerations;

(j) Geothermal issues where applicable.

2.3.2 Preliminary site evaluation

During the preliminary site evaluation phase the developer's professional advisor shall engage a geo-professional at an early stage to undertake a preliminary site evaluation and prepare a geotechnical assessment report where there is doubt about the stability or suitability of the ground for the proposed development, or there are any TA or local practice requirements for geotechnical involvement in the project.

In cases where more than a visual appraisal is deemed to be required, particular attention will need to be given to the following matters, as appropriate, which should normally be considered prior to preparing a proposal for development:

(a) Low impact design factors:

The preliminary site evaluation needs to take into account low impact design factors. These include consideration of maintaining and improving natural waterway features and optimising waterway crossing locations. Protection of well-drained soils and natural soakage areas also need to be taken into account.

(b) Drainage:

Identify the existing natural drainage pattern of any area and locate any natural springs or seepage. Where any overland flow paths or natural surface or subsurface drainage paths are interfered with or altered by earthworks, then appropriate measures should be taken to ensure that adequate alternative drainage facilities are provided to ensure there is no increase in flood hazard risk to the site or adjoining properties;

(c) Slope stability:

Some natural slopes exist in a state of only marginal stability and relatively minor disturbance such as trenching, excavation for streets or building platforms, removal of scrub and vegetation, or the erection of buildings, can lead to failure. Signs of instability include cracked or hummocky surfaces, crescent-shaped depressions, crooked fences, trees or power poles leaning uphill or downhill, uneven surfaces, swamps or wet ground in elevated positions, plants such as rushes growing down a slope, and water seeping from the ground. In addition, a simple desktop study of aerial photographs may show indications of historic failures as well as faulting, resulting in linear ground features. Refer to BRANZ Study Report 004, Crawford and Millar 1998, or the New Zealand Geotechnical Society publications Field description of soil and rock and Geotechnical issues in land development. For a sample checklist for geotechnical assessments refer to Crawford and Millar 1998. Existing or potential surface creep effects also need to be investigated and reported upon;

(d) Foundation stability:

A study of the general topography of the site and its surroundings may indicate areas which have previously been built up as a result of natural ground movement or by the deliberate placing of fill material. Unless such fill has been placed and compacted under proper control, instability or long-term differential settlement could occur causing damage to superimposed structures, roads, services, or other structures;

(e) Stream instability:

There is a potential for instability through changes to the current ground conditions, such as stream erosion;

(f) Local conditions:

A wide range of soil types exists throughout New Zealand which may need special consideration. Expansive soils, volcanic soils, soft alluvial sediments, and compressible soils are examples of these. Liquefaction of saturated non-cohesive soils should also be considered. The TA may have information on the soil types in its area, including potentially contaminated land;

(g) Peer review:

Where risk for the land prior to development is assessed as being medium to very high risk, a peer review of the geotechnical assessment for the proposed development may be required and this would need to be carried out by an independent geo-professional. (For guidance see *NZ Geomechanics News* (Crawford and Millar) for risk classification and (Cook et al) for peer review.)

C2.3.2

The preliminary evaluation should be carried out in the context of the total surroundings of the site, and should not be influenced by details of land tenure, territorial, or other boundary considerations. Where the preliminary evaluation discloses the potential for slope instability, other geotechnical or geological hazards, or the need for major foundations or for earthworks, the geo-professional should be involved at an early stage in the planning of the development.

2.3.3 Landform selection

The final choice of landform shall represent the most desirable compromise between the development requirements and the preservation of natural features and the natural character and landscape amenity values of the site including the retention of natural watercourses. Landform selection needs to take into account low impact design principles including retention of existing landforms and natural features where possible, and avoiding earthworks where there are existing habitats of indigenous species, wetlands, or areas of high natural character. The design shall take into account the following factors in making the selection of the final choice of the landform:

(a) The choice of a suitable landform may be specific to a particular site. An earthworks approach that respects and reflects the natural topography of the site is preferred. Considerations for carrying out earthworks include:

(i) The minimisation of the risk of damage to property occurring through ground movement in the form of slips, subsidence, creep, erosion, or settlement

(ii) The minimisation of the risk of damage to property occurring through flooding, or surface water run-off

(iii) The development of a more desirable roading pattern with improved accessibility to and within the site and the creation of a better sense of orientation and identity for the area as a whole

(iv) The efficiency of overall land utilisation including the quality of individual sites and amenity areas around buildings, the economics of providing engineering services, and the standard of roading and on-site vehicular access

(v) The need to create suitably graded areas for playing fields and other community facilities, and

(vi) The enhancement of the general environmental character of the area;

(b) The general nature and shape of the ground including:

(i) The geological nature and distribution of soils and rock

(ii) Existing and proposed drainage conditions, and the likely effects on groundwater

(iii) Previous history of ground movements in similar soils in the area

(iv) Performance of comparable cuts and fills (if any) in adjacent areas, and

(v) Air photography and other sources of information which should be reviewed and incorporated into any slope stability assessment;

(c) Soil data as applicable for areas which:

(i) Are intended to form in situ bases for fills

(ii) Are intended to yield material for the construction of fills

(iii) Are intended to be exposed as permanent batters, and

(iv) Are to remain as permanent slopes or cut areas;

(d) Borings, probings, or open cuts as necessary to:

(i) Classify the soil strata by field and visual methods

(ii) Evaluate the likely extent and variation in depths of the principal soil types, and

(iii) Establish the natural groundwater levels;

(e) Soil information required for:

(i) Further sampling and testing which may be required on representative soil types

(ii) Relating subsequent soil test properties to relevant strata over the site

(iii) Assessment and design for slope stability

(iv) Assessment and design for foundations suitable for the finished site, and

(v) Assessment and design for road subgrades.

The test data appropriate in different areas should be determined by the geo-professional.

2.3.4 Stability criteria

In making an assessment of the stability of slopes and earth fills, the geo-professional shall use accepted criteria and analysis methods. Stability criteria applicable to land development in New Zealand are published or recommended by the New Zealand Geotechnical Society (see Referenced Documents).

2.3.5 Special soil types

If special soil types are known to exist in a locality or are identified, then a geo-professional shall be engaged to advise on appropriate measures for incorporation of these soils into a development. Special soil types include, but are not limited to:

(a) Soils with high shrinkage and expansion;

(b) Compressible soils;

(c) Volcanic soils;

(d) Soils subject to liquefaction;

(e) Soils prone to dispersion (such as loess).

> ***C2.3.5***
>
> *The geo-professional should refer to the LA for hazard maps or information on special soil types in the locality if unfamiliar with the area.*

2.3.6 Compaction standards for fill material

The standard of compaction and method of determination shall be as set out in NZS 4431. Where NZS 4431 is not applicable, the methods and standards of compaction shall be specified by the geo-professional.

> ***C2.3.6***
>
> *Commercial and industrial developments often have specialised requirements for fill materials and compaction. In these cases the requirements of NZS 4431 may not be applicable. The geo-professional should set the fill standards and procedures for these developments.*

2.3.7 Erosion, sediment, and dust control

2.3.7.1 Minimisation of effects

Earthworks shall be designed and constructed in such a way as to minimise soil erosion and sediment discharge. Where necessary, permanent provision shall be made to control erosion and sediment discharge from the area of the earthworks.

Generation of dust during and after the earthworks operation shall be considered during the planning and design phase. If necessary, specific measures shall be incorporated to control dust.

> ***C2.3.7.1***
>
> *Most LAs have requirements for erosion, sediment, and dust control or these will be set in resource consents for the project. Such conditions should be referred to and taken into account in the early stages of planning a project.*

2.3.7.2 Protection measures

Where surface water could cause batter erosion or internal instability through infiltration into the soil, open interceptor drains shall be constructed in permanent materials, and benches in batter faces should be sloped back and graded longitudinally and transversely to reduce spillage of stormwater over the batter.

Water from stormwater systems shall be prevented from flowing into fill or into natural ground near the toe or sides of the fill.

No stormwater or wastewater soakage systems shall be constructed in fill or natural ground which could impair the stability of the ground.

Protection measures shall include the following as appropriate:

(a) Erosion control mechanisms:

   (i) Temporary drains to be constructed at the toe of steep slopes to intercept surface run-off and to lead away for treatment where required before discharge to a stable watercourse or pipe stormwater system

   (ii) Surface water to be diverted away from or prevented from discharging over batter faces and other areas of bare earth by bunds formed to intercept surface run-off and treated where required prior to discharge through stable channels or pipes, preferably into stable watercourses or piped stormwater systems

   (iii) The upper surface of fills to be shaped and compacted with rubber-tyred or smooth-wheeled plant when rain is impending, or when the site is to be left unattended to minimise water infiltration

   (iv) The completed battered surfaces of fills to be topsoiled and vegetated, or otherwise resurfaced to reduce run-off velocities

   (v) Control of erosion and sediment discharge may require planting, environmental matting, hydroseeding, drainage channels, or similar measures at an early stage in the earthworks construction phase

   (vi) Dust control may require frequent watering during construction along with establishment of the permanent surface at an early stage in the construction phase;

(b) Sediment management devices:

   (i) The surfaces of fills and cuts to be graded to prevent ponding

   (ii) Sediment traps and retention ponds to be constructed where they are necessary. These should be cleaned out, as required, to ensure that adequate sediment storage is maintained, with appropriate plans for decommissioning

(iii) Temporary barriers or silt fences using silt control geotextiles, to be used to reduce flow velocities and to trap sediment

(iv) Sections of natural ground to be left unstripped to act as grass (or other vegetation) filters for run-off from adjacent areas.

2.3.8 Seismic considerations

The geo-professional shall consider the seismic effects on earth fills, slopes, and liquefiable ground and shall take these into account in design and construction of any development in accordance with the scale of the development.

2.3.9 Retaining Walls

Where retaining walls are needed, specific design is required. Initial designs should be discussed with the Council before detailed design is carried out. The following are general criteria for retaining walls.

Retaining walls shall be designed of permanent materials and have an expected life in excess of 50 years. They should also be aesthetically designed to be compatible with the appearance of the surrounding area.

Safety barriers shall be provided in accordance with NZS 4404:2010 section 3.3.4 as modified by this code.

A building consent is required when there is a surcharge weight on the upper side of a retaining wall, or if the retaining wall is over 1500mm in height.

The approval of the Council is required for any works or structures on the road reserve. Approval will only be given where the Council is satisfied that no practical alternative exists to installing the structure on the road carriageway.

All walls within the road reserve shall be designed by a Chartered Professional Engineer in accordance with the NZ Building Code and a building consent obtained where required. Retaining walls below any road carriageway, and supporting road reserve shall be designed to allow for future vehicle surcharging (from anywhere in the road reserve) against the wall.

The design shall consider future maintenance requirements including drainage maintenance. This includes allowance for mowing of grassed areas by installing mowing strips.

2.3.10 Cut and fill batters

A suitably qualified person shall provide a site-specific design (including benching if appropriate) for approval by Council where cut or fill batters:

- Are steeper than 2 horizontal to 1 vertical;
- Exceed 3m in height;
- Are constructed using moisture content susceptible soils; or
- Have features that Council deems to require specific engineering input.

The minimum width of any bench shall be 1.8m. Stormwater shall be conveyed to a point clear of the filling and discharge in such a manner as to prevent erosion.

Unless formed in rock, all batters shall be formed such that they may be reinstated with grass or other consistent vegetation.

The edge of the batter should be a minimum of 600mm behind the kerb or back edge of the footpath.

Safety barriers shall be provided in accordance with NZS 4404:2010 section 3.3.4 as modified by this code.

2.4 Approval of proposed works

The approval process for land development and subdivision design and construction shall be in accordance with section 1 of this Code of Practice. Land stability assessments and the design and control of earthworks require approval from the LAs.

2.5 Construction

Earthworks shall be carried out to the standards detailed in the approved specifications and drawings, and any requirements in a regional or district plan or consent issued by the LA.

The construction control testing shall be carried out by a testing laboratory or competent person under the control of the geo-professional, and to the recognised testing standards as deemed appropriate.

The testing laboratory shall have recognised registration or quality assurance qualifications.

2.6 Final documentation

2.6.1 Geotechnical completion report

For all developments where a geo-professional is engaged the geo-professional shall submit a geotechnical completion report to the developer and the TA accompanied by a statement of professional opinion as set out in Schedule 2A. The geotechnical report shall identify any specific design requirements which would necessitate the building design deviating from NZS 3604.

The expected level of site movement from reactive soil (expansive soils) under AS 2870:1996 shall be identified by their respective class and included in the geotechnical completion report. The soil properties used in determining the class are to be recorded in the report. The site subsoil class to the provisions of NZS 1170.5 section 3 and NZS 1170.5 Supp 1 C3.1.3 shall be identified in the geotechnical completion report.

The report shall describe the extent of inspection, revisit and review all inferences and assumptions made during the investigation, assess the results of testing and state the geo-professional's professional opinion on the compliance of the development with the standards set by the geo-professional. The report shall also include all geotechnical reports prepared for the development.

Documentation on the testing of the soils for compaction shall be included in the geotechnical completion report. This documentation should clearly show the areas in which compaction met the required standards, as well as any areas requiring retesting, and areas which did not meet the standards.

For developments where there are no earthworks the geotechnical completion report will comprise the geotechnical assessment report. For large or more complex developments where there may have been several stages of geotechnical reporting, all prior reports covering the subject area of land under certification shall be included in the geotechnical completion report. The geotechnical completion report shall identify areas that provide good ground as defined in NZS 3604. Those areas that require specific design for stability and foundation design shall also be noted.

2.6.2 As-built drawings for earthworks and subsoil drains

Where earthworks have occurred, an as-built plan shall be prepared showing finished contours. The plans shall also show original contours where earthworks have occurred to illustrate the extent and depth of cuts and fills. Alternative methods of representing earthwork depths may be acceptable including plans showing lines joining all points of equal depth of cut and fill at appropriate vertical intervals. The as-built plans shall also record the position, type, and size of all subsoil drains and their outlets, and show any areas of fill or natural ground which the geo-professional considers do not comply with this Code of Practice or areas where the standards have been varied from the original construction specification.

These plans shall be made available to the TA and the developer in conjunction with the geotechnical completion report.

SCHEDULE 2A

STATEMENT OF PROFESSIONAL OPINION ON SUITABILITY OF LAND FOR BUILDING CONSTRUCTION

Development ....

Developer ....

Location...

I .... of ....

(Full name) *(Name and address of firm)*

Hereby confirm that:

1. I am a geo-professional as defined in clause 1.2.2 of NZS 4404:2010 and was retained by the developer as the geo-professional on the above development.
2. The extent of my preliminary investigations are described in my Report(s) number ...., dated ...., and the conclusions and recommendations of that/those document(s) have been re-evaluated in the preparation of this report. The extent of my inspections during construction, and the results of all tests and/or re-evaluations carried out are as described in my geotechnical completion report dated ....
3. In my professional opinion, not to be construed as a guarantee, I consider that (delete as appropriate):

   (a) The earth fills shown on the attached Plan No...................... have been placed in compliance with the requirements of the .... Council and my specification.

   (b) The completed works take into account land slope and foundation stability considerations, subject to the appended foundation recommendations and earthworks restrictions, (which should be read in conjunction with the appended final site contour plan).

   (c) Subject to 3(a) and 3(b) of this Schedule, the original ground not affected by filling is suitable for the erection of buildings designed according to NZS 3604 provided that:

   (i)..

   (ii)..

   (d) Subject to 3(a) and 3(b) of this Schedule, the filled ground is suitable for the erection of buildings designed according to NZS 3604 provided that:

   (i) ....

   (ii)..

   (e) The original ground not affected by filling and the filled ground are not subject to erosion, subsidence, or slippage in accordance with the provisions of section 106 of the Resource Management Act 1991 provided that:

   (i) ....

   (ii)..

NOTE – These subclauses may be deleted or added to as appropriate, to include such considerations as expansive soils where excluded from NZS 3604, and site seismic characteristics as covered in clause 3.1.3 of NZS 1170.5.

4. This professional opinion is furnished to the TA and the developer for their purposes alone on the express condition that it will not be relied upon by any other person and does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any building.
5. This certificate shall be read in conjunction with my geotechnical report referred to in clause 2 above and shall not be copied or reproduced except in conjunction with the full geotechnical completion report.

Signed.. Date..

....

....

....

(Name, title, and professional qualifications)

Copyright waived

3 Roads

Where community specific guidelines are available these shall be taken into consideration throughout the design and construction of subdivisions and development. Where community specific considerations cannot be met, written acceptance of an alternative method shall be obtained from the Council

3.1 Scope

This section sets out requirements for the design and construction of roads for land development and subdivision. Section 3 provides engineering design and construction solutions for most situations.

3.2 General

3.2.1 Objective

The objective is to provide roads that are safe for all road users and designed to the context of their environment. Roads shall be capable of carrying all utility services underground, provide for the management of stormwater, and contribute to quality urban design.

3.2.2 Related Standards and guidelines

A selection of currently available documents which provide an appropriate basis for road design is set out in Referenced Documents. Related Documents lists additional material that may be useful. These are not exclusive. Other Standards, guidelines, and design responses may be used where appropriate and accepted by the TA.

Standards and Guidelines shall include all policies and guidelines adopted by the Council

3.2.3 Road purpose

Roads serve a number of purposes that enhance quality of life in neighbourhoods, towns, and cities; improve opportunities for business in commercial areas; and meet a range of local, regional, and national goals for access, mobility, and land use.

Roads serve the following functions:

(a) A **place** for access and interaction, including:

- (i) Providing for human interaction
- (ii) Facilitating commerce and business
- (iii) Enabling access to buildings, lots, and public spaces
- (iv) Parking;

(b) A **link** for connection and movement of people and goods including the following user groups:

- (i) Pedestrians
- (ii) Cyclists
- (iii) Public transport
- (iv) Freight and goods vehicles
- (v) Private motor vehicles
- (vi) Other modes which are not vehicles;

(c) A **corridor** for utility and amenity infrastructure, including:

(i) Stormwater treatment and conveyance

(ii) Road lighting

(iii) Landscaping and street furniture

(iv) Utility services

(v) Signals, signs, and markings

(vi) Safety, convenience, and crime prevention.

3.2.4 Place and link context

The two fundamental roles of a road are to provide a space for interaction between people for a range of purposes and access to land uses so that movement between places can occur.

3.2.4.1 Place context

Place context is defined for both the specific land use served and the broader area type in which it is located.

The land use characteristic is defined according to the description of predominant activities in individual areas. Descriptions include live, play, shop, work, and learn, in addition to activities associated with growing, manufacturing, and transporting goods and products.

Table 3.1 describes the relationship between land use, area type, and transport context. Table 3.1 should be used as a guide for decision-making on transport infrastructure and services. This table addresses:

(a) **Geographic area**: Four area types are identified to establish the context of place: rural, suburban, urban, and centre.

(b) **Land use**: Four land use types are identified: live and play (residential and parks), shop and trade (retail and services), work and learn (offices and schools), and make, grow, and move (agricultural, industrial, and warehouses).

(c) **Transport**: As a matrix, the area context and land use classification system describe sixteen individual place contexts that indicate the types, times, intensity, and mode of trips that can be expected to occur in neighbourhoods. This land use framework describes the typical elements of road links that are to accommodate the needs of the expected users.

Table 3.1 – Land use and area type matrix describing typical place and transport context

LAND USE	AREA TYPE			
	RURAL	**SUBURBAN**	**URBAN**	**CENTRE**
LIVE AND PLAY (Residential and parks) Homes, home-based businesses, and mixed use developments with residential uses, as well as parks and low impact recreation. *Transport: These land uses primarily generate home-based and internal circulation trips (recreation, social, school, and retail). Home-based work trips are concentrated at peak periods, while other types of trips are dispersed across time periods. Streets to these land uses prioritise recreation walking and cycling over vehicle movement.*	Low density, generally no more than 4 units per hectare located outside the urban limits. *Transport: Private motor vehicles are the predominant form of transport with low trip volumes throughout the day.*	Low and moderate density housing generally up to 15 units per hectare in an area where housing is the exclusive or dominant use. *Transport: Private vehicles are the predominant form of transport but public transport should provide peak period service on arterials and connector/collectors. Non-motorised trips are primarily recreational and occur on local roads.*	Moderate and high density housing often in combination with other uses such that combined population of residents, employees, and students is typically 50 per hectare or greater. *Transport: A higher portion of trips are made on public transport and by walking and cycling. There is lower priority for the provision of residential parking in urban areas.*	Moderate and high density housing often in combination with other uses such that combined population of residents, employees, and students is typically 200 per hectare or greater. *Transport: Residents typically walk or cycle to nearby destinations and rely on public transport for longer trips, and they may choose not to own a vehicle. Provision for residential and commuter parking is a low priority in centres.*
SHOP AND TRADE (Retail and services) Retail or other service where most trips to the business are by customers and clients, rather than employees. *Transport: A large volume of destination trips occur across time periods, especially weekends and peak shopping times to these land uses. A low-to-moderate volume of freight truck traffic is served. Streetscapes may serve as connections for destination users to reach several or numerous businesses in the area.*	Isolated or small clusters of stores or service-based businesses located outside the urban limits. *Transport: Most trips are made in private motor vehicles with low trip volumes throughout the day.*	Includes both traditional town centres and newer shopping centres of generally 1-2 storeys where the dominant use is retail and services businesses and the combined retail and commercial floor-to-area ratio (FAR) is typically under 0.3 (gross). *Transport: Most trips are made in private motor vehicles with moderate and high trip volumes, especially on weekends,*	Retail and services focused in a town centre or concentrated along an urban corridor in combination with other uses. The combined population of residents, employees, and students is typically 50 per hectare or greater. *Transport: Trips are made on a variety of modes at all times with limited amounts of shared and paid parking.*	Moderate to high density land uses include retail mixed with other uses in an urban or town centre. Centres typically have, or are planned to have, a combined population of residents, employees, and students of 200 per hectare or greater. *Transport: Public transport services are typically focused on centres, and centres are among the most highly*

LAND USE	AREA TYPE			
	RURAL	SUBURBAN	URBAN	CENTRE
		requiring these land uses to have large amounts of parking allocated to each site.		*connected and walkable environments. Provision for parking is the lowest land use priority in centres.*

Table 3.1 – Land use and area type matrix describing typical place and transport context (continued)

LAND USE	AREA TYPE			
	RURAL	SUBURBAN	URBAN	CENTRE
WORK AND LEARN (Offices and schools) Areas dominated by businesses or schools where the most important trips to the business are made by employees (typically offices) and students. *Transport: A large volume of destination trips occur at peak periods on weekdays. A low-to-moderate volume of freight truck traffic is served. Streetscapes may serve as connections for a variety of users, especially during lunch periods as well as other times when clients or customers may visit work places. Roads near schools will require special design needs to accommodate younger pedestrians.*	Individual or small clusters of activities located outside the urban limits, such as school campuses and research facilities. *Transport: Most trips are made in private motor vehicles with most trips occurring during peak periods.*	Low rise office buildings (typically 1-2 storeys) and school campuses with an area wide average FAR of less than 0.3, including any retail component. *Transport: Most trips are made in private motor vehicles during peak periods, requiring these land uses to have large amounts of parking allocated to each site.*	Low and mid-rise office buildings that often include street-front retail and services focused in a town centre or concentrated along an urban corridor. The combined population of residents, employees, and students is typically 50 per hectare or greater. *Transport: Trips are made on a variety of modes at all times with limited amounts of shared and paid parking.*	Mid-rise and high-rise office buildings that usually include mixed uses, including street-front retail and multi-family housing. Centres typically have, or are planned to have, a combined population of residents, employees, and students of 200 per hectare or greater. *Transport: Public transport services are typically focused on centres, and centres are among the most highly connected and walkable environments. Provision for parking is the lowest land use priority in centres.*

MAKE, GROW, AND MOVE (Agricultural, industrial, and warehouses) Areas dominated by businesses where the most important trips to the business are made by heavy delivery trucks (typically farms, warehouses, and industries). *Transport: A moderate-to-large volume of freight trips occur (year around or seasonally) and should be accommodated in the road link network. Streetscapes are designed to accommodate heavy freight movements. Where these are larger in number and need to be served, the freight, link function is crucial to service the land use function.*	Farms, light industry, and warehouses located outside the urban limits. *Transport: Road links are predominantly designed to accommodate freight truck movements and those generated by employees and business customers, Special vehicle areas may be provided to accommodate specialised freight needs.*	Industrial parks. *Transport: Road links are predominantly designed to accommodate freight truck movements and those generated by employees and business customers. Parking may also be provided for some employees, and special vehicle areas may be provided to accommodate specialised freight needs*	Would not normally occur except where activities have little impact on or otherwise support surrounding land uses.	Would not normally occur except where activities have little impact on or otherwise support surrounding land uses.

3.2.4.2 Link context

Link context is classified by the extent of access and the degree of through movement intended to be served. This Code of Practice includes three levels of link context:

(a) Lane: A road that provides very high local access and very limited though movement connectivity. Very low vehicle speeds with shared pedestrian and vehicle access predominate;

(b) Local road: A road that provides access and connectivity for a local area. Low vehicle speeds, pedestrian and local amenity values predominate;

(c) Connector/collector road: A road that provides circulation in local areas and links to arterial roads, while balancing this with pedestrian and local amenity values. Higher vehicle speeds and access for all modes of transport including public transport predominate.

> ***C3.2.4.2***
>
> *Arterial roads and motorways are not included in this* Code of Practice*. These roads are subject to specific design standards to be agreed with the road controlling authority to ensure through movement connectivity associated with the broader sector in which such roading is located. The following descriptions are included for information:*
>
> (a) ***Minor arterial road****: A road that provides access between connector/collector and major arterial roads. Minor arterial roads have a dominant through vehicular movement and carry the major public transport routes. Access to property may be restricted and rear servicing facilities may be required. Urban traffic volumes are typically 8,000 vpd to 20,000 vpd and rural from 1,000 to 5,000 vpd with a higher proportion of heavy vehicles. Typical urban operating speeds are 40 to 60 km/h and rural 80 to 100 km/h.*
>
> (b) ***Major arterial road****: A road that provides interconnections between major sectors of a large area linked with external areas and distributes traffic from major intercit ylinks. Access is generally at grade but may be limited. Urban traffic volumes are typically greater than 20,000 vpd and rural 5,000 vpd with a significant number of heavy vehicles. Typical urban operating speeds are 50 to 70 km/h and rural 80 to 100 km/h.*
>
> (c) ***Motorway****: Motorways have the highest link function and have no frontage access. Typical operating speed is 100 km/h.*

3.2.5 Network connectivity

Well-connected networks (roads and other links) are achieved with smaller block sizes and regular connections. Network connectivity shall be designed to achieve:

(a) Shorter travel distances;

(b) An increased number of alternative routes for all types of users;

(c) Increased opportunity for interaction;

(d) Improved access to public transport, cycling and walking networks, and access to destinations.

Development design shall ensure connectivity to properties and roads that have been developed, or that have the potential to be developed in the future. The design process should ensure the following maximum walking distances from a lot to a connector/collector or arterial road:

(a) **Rural**: No maximum distance. The design should maximise future connectivity to a suburban network;

(b) **Suburban**: 400 m. A shorter distance shall be considered near centres and major public transport routes;

(c) **Urban**: 300 m;

(d) **Centre**: 200 m.

Where factors, such as topography or barriers, limit the ability to achieve the network connectivity standard, the designer shall optimise network connectivity and access to the maximum extent practical. The designer shall maximise connectivity to existing development.

3.2.6 Design and access statement

A design and access statement shall be submitted with the application for design approval. The statement shall cover all relevant aspects of 3.2 and 3.3 of this Code of Practice and specifically address:

(a) Road dimensions and layout;

(b) Link and place functions;

(c) Connectivity;

(d) How target operating speeds will be achieved;

(e) How LID principles have been considered for stormwater run-off from the roads.

(f) How cyclists will be provided for

In addition a design and access statement shall evaluate the effects of the proposed development at its ultimate extent (and staged, where applicable) on the surrounding communities and transportation network.

> ***C3.2.6***
>
> *Design and access statements allow the basis of the road design to be independently reviewed, and should be sufficient to illustrate the reasons for the design selections.*

3.2.7 Road safety audit

Road safety audits carried out in accordance with the NZTA Road safety audit procedures for projects shall be provided for both design and post construction phases of all roads to be vested in the Council. Any recommendations of the Safety Audits shall be completed to the Council's satisfaction. Exemption from providing road safety audits shall be granted by the Council at its sole discretion. Road safety audits shall also be provided for private road networks when considered necessary by QLDC.

Safety audits should cover all road users, including the needs of pedestrians, cyclists, and disabled/elderly users. Where appropriate, the requirements of these groups may demand specific audit procedures.

3.3 Design

3.3.1 Design requirements

Table 3.2 should be used as the basis for road design. Road widths shall be selected to ensure that adequate movement lanes, footpaths, berms, and batters can be provided to retain amenity values (including landscaping) and enable utility services to be provided safely and in economically accessible locations. Road widths shall be planned to cope with estimated long-term community needs even though construction may be carried out only to shorter-term requirements.

Alternative carriageway widths may be adopted to suit particular design considerations. These shall be subject to specific design consideration and approval by the TA. Such cross sections may include landscaped features, painted median facilities, or variations to parking provision. Carriageways should avoid widths of 5.7 m to 7.2 m and 7.5 m to 9.0 m where these widths may cause confusion between movement and parking functions.

C3.3.1

In the case of a rear access lane, the concept relies heavily on minimal garage setback from the lane frontage. Rear access lanes are required to provide for manoeuvring for access to/from garages. Where the garages are located on or close to the lane edge the manoeuvring requirement may necessitate a wider lane dimension or increased setback. In this sense, a key function of the lane is to operate akin to an aisle within a car parking area and needs to be designed accordingly. A single lane sealed width with widening at the garage locations for turning is the minimum requirement. Sealing the entire lane increases opportunities for the lane to be used in a social sense. It is therefore desirable for the entire lane to be sealed, although a narrow berm for services may be necessary.

There are three carriageway types. These are:

(a) *A width in the range 5.5 m – 5.7 m providing for ability to park on one side of the road and one through lane, or alternatively two through lanes. This is often not defined at the engineering stage and is instead left to road users to choose. This type of road is provided for in the standard and is typically appropriate for shorter streets of up to approximately 250 m, to assist with achieving a slower operating speed.*

(b) *A width in the range of 7.2 m – 7.5 m providing an ability for either two parked cars and one through movement, or one parked car and two through movements. This is typically not defined through the provision of parking bays although it may be. There may be cases in lower parking demand situations where this width is achieved with varied pinch points to provide a road with two through lanes and a parking bay.*

(c) *A width in the range 9.0 m – 9.5 m providing ability for two through lanes and two parking lanes. Depending on parking demand this can either be achieved with landscaping such as tree boxes/pits and recessed parking, or by maintaining full flexibility with a straight edge.*

The designer shall consider the environment, purpose, and function of the road being designed. In developing a design cross section the designer shall consider the relationships between speed, parking and its frequency, and the shared or recessed nature of parking in the movement lanes. In general a wider standard total carriageway cross section can be developed where parking is shared in the movement lane, however if this is not a frequent occurrence then the outcome will be an unnecessarily wide road and the target speed outcome will not be achieved without other managed intervention. Where parking is less frequent, consideration shall be given to narrowing the travelling carriageway and recessing the parking or to introducing landscaping into the carriageway to reduce the appearance of apparent formed width. Where the designer proposes to develop a shared street design that varies from that shown in table 3.2, a full description and assessment of the frequency and extent of interactions of this nature shall be described in the design and access statement.

Roads shall be designed to account for stormwater and keep potential groundwater below structural pavement layers. On rural roads, side drains or swales shall be provided to carry stormwater and keep potential groundwater below structural pavement layers. All roads, including footpaths and cycleways, shall be adequately drained in accordance with good engineering practice. Roads also have the potential to provide stormwater ponding and overland flow paths when the primary system is overloaded (see 4.3.4.2).

In soils of adequate permeability and favourable topography, the use of low impact design soakage systems and devices shall be considered to provide benefits of attenuating peak flows and improving run-off quality. For detailed design criteria for soakage systems and devices see 3.3.19.5, 4.3.7.6, and 4.3.7.9.

Any design should be coordinated with the relevant landscape design requirements covered in section 7.

Table 3.2 should be read in conjunction with 3.3.1.1 to 3.3.1.10.

All designs shall be suitable for the climatic conditions experienced in the Queenstown Lakes District.

And

The assessment of traffic loading shall be on the basis of full development to the extent defined in the current district plan. Where a road services adjacent land then the full development to the extent defined in the current district plan of all the land serviced by the road shall be included in the assessed traffic loading.

The assessment of residential traffic loading shall be on the basis of eight vehicle movements per Residential Unit per day.

Where the new roads being installed are required by Council to service adjacent future development as part of the future Council network then those roads will be designed and constructed on the basis of full development to the extent defined in the current district plan.

The cost of increased road construction to service adjacent future development will be apportioned between the applicant and the Council and agreed in writing with the Council’s Asset Performance Team prior to construction.

3.3.1.1

A movement lane may include a single lane operating in a one-way configuration or in two directions. Normal camber is 3%. Maximum super elevation is 6%.

3.3.1.2

No more than one movement lane in each direction is typical. Streets in urban areas and centres may include a single movement lane operating as a one-way street.

3.3.1.3

Each parking/passing area should be a minimum 2.1 x 6 m, and a loading area a minimum 2.5 x 12 m, each with appropriate entry and departure tapers outside of the movement lane. Provision is to be made on one lane two way carriageways for passing every 50 m and at corners.

3.3.1.4

Where not shown in the table cyclists shall be provided with separate movement lanes if identified in a local or regional cycle network.

3.3.1.5

Side and rear access should not be the primary access.

3.3.1.6

Shoulder widths on rural roads need to be assessed for each project based on the speed environment of the area and terrain. For high speed environments where high non-motorised use is expected, shoulder widths may need to be increased to optimise overall road safety.

3.3.1.7

Minimum gradient is 0.4%. Maximum gradients shall be as indicated in the table. Steeper gradients may be acceptable for shorter lengths of road in hilly country or low overall speed environments subject to TA approval.

3.3.1.8

In some circumstances an increased overall road reserve may be necessary for utilities provision or increased amenity, landscape or urban design element. Specific design shall be undertaken and agreed with the territorial authority where road reserves are to be reduced. In other circumstances, reserve widths may be reduced if a one way road, or development is on one side of the road

3.3.1.9

All carriageways shall be sealed for the first 10 m from the intersection with another road.

Private access ways and drive ways shall also be sealed from the carriageway to the property boundary

3.3.1.10

Where the gradient of a public road is steeper than 12.5%, a resolution of the TA or a District Plan allowance is required. Refer to s. 329 (road gradients) of the Local Government Act 1974.

NOTE – The typical plan and cross section images in table 3.2 are also set out in Appendix E. Copyright on these is waived.

3.3.2 Road geometric design

3.3.2.1 Design parameters

Roads shall be designed to accepted standards generally satisfied by table 3.2 of this Code of Practice or the use of the relevant Austroads guides, and guides listed in Referenced Documents and Related Documents for other facilities.

3.3.2.2 Sight distance

All roads shall be designed with sight distances that match the target operating speed. Reducing a driver's field of vision in conjunction with other design and management measures is a recognised method for achieving an appropriate speed environment (see 3.3.5).

On connector/collector and arterial roads, sight distance criteria at intersections as well as for stopping, overtaking, on curves, and to avoid obstructions should be applied in accordance with the relevant Austroads or NZTA guides.

3.3.2.3 Widening on horizontal curves

In some areas the developed road geometry may be constrained, horizontal alignments may involve low radius, or the proportion of commercial vehicles may predominate, such as in a make and move environment. In such instances, movement lanes shall be assessed to determine the need for localised additional width, for example on low radius horizontal curves where the passage of vehicles has the potential to reduce safety. The Austroads *Guide to road design* – Part 3: *Geometric design* provides useful guidance on this.

Table 3.2 – Road design standards

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION	FIGURE NUMBER
Area	Land use	Local attributes	Locality served	Target operating speed (km/h)	Min. road width (m)	Max. grade	Pedestrians	Passing, parking, loading, and shoulder	Cyclists	Movement lane (excluding shoulder)	Classification	SEE APPENDIX E FOR LARGER VERSION OF FIGURES	
Notes	See 3.2.4, table 3.1 & 3.3.1.6	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.5, 3.3.7, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
Rural (3.3.1.7, 3.3.1.8, & 3.3.1.9)	Live and play	Access to lifestyle or clustered housing	1 to 6 du	20	6	20%	Shared (on shoulder and berm)	Allow for passing up to every 50 m, total shoulder 0.5 m, sealed	Shared (in movement lane)	2.50	Lane (this would normally be a private road or private way)		E1
	Live and play	Access to lifestyle or clustered housing	1 to 20 du	30	9	16%	Shared (on shoulder and berm)	Total shoulder 0.5 m, sealed	Shared (in movement lane)	5.5 - 5.7	Lane (~ 200 vpd)		E2

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4, table 3.1 & 3.3.1.6	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.5, 3.3.7, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Live and play	Access to housing	1 to 150 du	70	15	12.5%	Shared (on shoulder and berm)	Total shoulder 1.0 m, sealed shoulder 0.5 m	Shared (in movement lane)	5.5 - 5.7	Local road (~ 1000 vpd)		E3
Rural (3.3.1.7, 3.3.1.8, & 3.3.1.9)	Shop and trade	Side or rear service access	Up to 100 m in length between streets, 1 to 20 lots	10	6	16%	Shared (in movement lane)	Allow for passing up to every 50 m. Kerbed edge or total shoulder 0.5 m, sealed	Shared (in movement lane)	2.75 - 3.00	Lane (~ 200 vpd)		E4

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	Land use	Local attributes	Locality served	Target operating speed (km/h)	Min. road width (m)	Max. grade	Pedestrians	Passing, parking, loading, and shoulder	Cyclists	Movement lane (excluding shoulder)	Classification		
Notes	See 3.2.4, table 3.1 & 3.3.1.6	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.5, 3.3.7, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Shop and trade	Access to trade	Rural village shops	40	15	10%	1.5 m each side	Parking and loading may occur in the movement lane or be separate and recessed. See 3.3.6. Kerbed edge or total shoulder 1.0 m, sealed shoulder 0.5 m	Shared (in movement lane)	5.5 - 5.7	Local road (~ 1,000 vpd)		E5
	Make and move	Primary freight access	Rural activities	up to 100	20	10%	1.5 m each side	Total shoulder 1.0 m, sealed shoulder 0.5 m	On sealed shoulder where it is a local authority defined cycle route	5.5 - 5.7	Local road (~ 1,000 vpd)		E6

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION	FIGURE NUMBER
Area	Land use	Local attributes	Locality served	Target operating speed (km/h)	Min. road width (m)	Max. grade	Pedestrians	Passing, parking, loading, and shoulder	Cyclists	Movement lane (excluding shoulder)	Classification	SEE APPENDIX E FOR LARGER VERSION OF FIGURES	
Notes	See 3.2.4, table 3.1 & 3.3.1.6	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.5, 3.3.7, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
Rural (3.3.1.7, 3.3.1.8, & 3.3.1.9)	Make and move	Access to office and education	1 to 200 lots	up to 60	20	10%	1.5 m each side	Parking and loading may occur in movement lane or be separate and recessed. Refer clause 3.3.6. Total shoulder 1.0 m, sealed shoulder 0.5 m	On sealed shoulder where it is a local authority defined cycle route	5.5 - 5.7	Local road (~ 1,000 vpd)		E7
	All other situations (where not specified elsewhere)	All (serving land uses not specified elsewhere in this table)	-	up to 100	20	10%	Separate from the carriageway, 1.5 m each side	Total shoulder 1.5 m, sealed shoulder 1.0 m	On sealed shoulder where it is a local authority defined cycle route	5.5 - 5.7	Connector/collector (~ 2,500 vpd)		E8

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**	SEE APPENDIX E FOR LARGER VERSION OF FIGURES	
Notes	See 3.2.4, table 3.1 & 3.3.1.6	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.5, 3.3.7, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
Suburban	**Live and play**	Access to houses/ townhouses	1 to 3 du or 1 to 6 du	10	3.6 m for up to 3 du or 4.5 m for up to 6 du	20%	Shared (in movement lane)	Allow for passing up to every 50 m	Shared (in movement lane)	2.75 - 3.0	Lane (this would normally be a private road or private way)		**E9**
Suburban	**Live and play**	Side or rear service access	Up to 100 m in length between streets, 1 to 20 lots	10	6	16%	Shared (in movement lane)	Allow for passing up to every 50 m	Shared (in movement lane)	2.75 - 3.00	Lane (~ 200 vpd)		**E10**

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4, table 3.1 & 3.3.1.6	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.5, 3.3.7, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Live and play	Access to houses/ townhouses	1 to 20 du	20	9	16%	Shared (in movement lane)	Shared (in movement lane)	Shared (in movement lane)	5.5 - 5.7	Lane (~ 200 vpd)		**E11**
	Live and play	Primary access to housing	1 to 200 du	40	15	12.5%	1.5 m one side or 1.5 m each side where more than 20 du or more than 100 m in length	Shared parking in the movement lane up to 100 du, separate parking required over 100 du	Shared (in movement lane)	5.5 - 5.7	Local road (~ 2,000 vpd)		**E12**

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4, table 3.1 & 3.3.1.6	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.5, 3.3.7, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
Suburban	Live and play	Primary access to housing	Up to 800 du	50	20	10%	2.0 m each side	Parking is separate and recessed. See 3.3.6. Public transport is likely (see clause 3.3.1.4, 3.3.1.5)	Separate provision where local authority defined cycle route	2 x 4.2	Connector/collector (~ 8,000 vpd)		E13
Suburban	Shop and trade, work and learn	Side or rear service access	Suburban village, access to office and education, 1 - 20 lots	10	6	10%	Shared (in movement lane)	Recessed loading bays in accordance with 3.3.6	Shared (in movement lane)	3.5	Lane (~ 200 vpd)		E14

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4, table 3.1 & 3.3.1.6	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.5, 3.3.7, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Shop and trade, work and learn	Access to trade, office and education	Suburban village 1 - 200 lots	40	18	10%	3.0 m each side	Parking and loading bays both sides may be in the movement lane or recessed. See 3.3.6	Shared (in movement lane)	5.5 - 5.7	Local road (~ 2,000 vpd)		**E15**
Suburban	**Make and move**	Side or rear freight access	Industrial area	10	11	10%	Separate footpath one side	Loading bays shall be separate and recessed. See 3.3.6	Shared (in movement lane)	3.5	Lane (~ 200 vpd)		**E16**

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	Land use	Local attributes	Locality served	Target operating speed (km/h)	Min. road width (m)	Max. grade	Pedestrians	Passing, parking, loading, and shoulder	Cyclists	Movement lane (excluding shoulder)	Classification		
Notes	See 3.2.4, table 3.1 & 3.3.1.6	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.5, 3.3.7, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Make and move	Primary freight access	Industrial area	40	18	10%	1.5 m each side	Parking and loading bays both sides may be in the movement lane or recessed. See 3.3.6	Shared (in movement lane)	2 x 4.2	Local road (~2,000 vpd)		E17
	Shop and trade, work and learn, make and move	All, roads serving multi-purpose areas involving most or all of the indicated land uses, not specified elsewhere in this table.	All, or combinations of these land uses	50	23	10%	2.5 m each side, 3.5 m each side for shop and trade, work and learn	Parking separate and recessed. See 3.3.6. Public transport is likely (see 3.3.1.4, 3.3.1.5)	Separate provision where local authority defined cycle route	2 x 4.2	Connector/collector (~ 8,000 vpd)		E18

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**	SEE APPENDIX E FOR LARGER VERSION OF FIGURES	
Notes	See 3.2.4, table 3.1 & 3.3.1.6	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.5, 3.3.7, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
Urban	Live and play	Access to lifestyle or clustered housing	1 to 3 du or 1 to 6 du	10	3.6 m for up to 3 du or 4.5 m for up to 6 du	20%	Shared (in movement lane)	Allow for passing up to every 50 m	Shared (in movement lane)	2.75 - 3.0	Lane (this would normally be a private road or private way)		E19
Urban	Live and play	Side or rear service access	1 to 20 du	10	6	16%	Shared (in movement lane)	Parking is required and shall be separate and recessed	Shared (in movement lane)	2.75 - 3.00	Lane (~ 200 vpd)		E20

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4, table 3.1 & 3.3.1.6	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.5, 3.3.7, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Live and play	Access to houses / townhouses	1 to 20 du	20	9	16%	Shared (in movement lane)	Shared (in movement lane)	Shared (in movement lane)	5.5 - 5.7	Lane (~ 200 vpd)		**E21**
Urban	**Live and play**	Primary access to housing	1 to 200 du	30	15	12.5%	1.5 m one side or 1.5 m both sides where more than 20 du or more than 100 m in length	Parking may occur in the movement lane or be separate and recessed. See 3.3.6	Shared (in movement lane)	5.5 - 5.7	Local road (~ 2,000 vpd)		**E22**

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION	FIGURE NUMBER
Area	Land use	Local attributes	Locality served	Target operating speed (km/h)	Min. road width (m)	Max. grade	Pedestrians	Passing, parking, loading, and shoulder	Cyclists	Movement lane (excluding shoulder)	Classification	SEE APPENDIX E FOR LARGER VERSION OF FIGURES	
Notes	See 3.2.4, table 3.1 & 3.3.1.6	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.5, 3.3.7, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Live and play	All other land use activity types within this area type not specified elsewhere in this table.	All	50	20	10%	2.0 m each side	Parking separate and recessed. See 3.3.6. Public transport is likely (see 3.3.1.4, 3.3.1.5)	Separate provision where local authority defined cycle route	2 x 4.2	Connector/collector (~ 8,000 vpd)		E23
	Shop and trade	Side or rear service access	1 to 20 lots	10	6	16%	Shared (in movement lane)	Loading bays shall be recessed	Shared (in movement lane)	2.75 - 3.00	Lane (~ 200 vpd)		E24

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4, table 3.1 & 3.3.1.6	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.5, 3.3.7, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
Urban	Shop and trade	Access to lots or shop or trade units	1 to 20 lots	10	11	12%	Shared (in movement lane)	Parking may occur separate and recessed. See 3.3.6	Shared (in movement lane)	2.75 - 3.00	Lane (~ 200 vpd)		E25
Urban	Shop and trade	Primary access to trade	1 to 200 lots	30	20	10%	3.5 m each side	Parking and loading bays may occur in the movement lane or be separate and recessed. See 3.3.6	Shared (in movement lane)	5.5 - 5.7	Local road (~ 2,000 vpd)		E26

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4, table 3.1 & 3.3.1.6	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.5, 3.3.7, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Work and learn	Side or rear service access	1 to 20 lots	10	6	16%	Shared (in movement lane)	Parking and loading bays shall be separate and recessed. See 3.3.6	Shared (in movement lane)	2.75 - 3.00	Lane (~ 200 vpd)		E27
Urban	Work and learn	Access to lots or work or learn activities	1 to 20 lots	10	11	12%	Shared (in movement lane)	Parking and loading bays shall be separate and recessed. See 3.3.6	Shared (in movement lane)	2.75 - 3.00	Lane (~ 200 vpd)		E28

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	Land use	Local attributes	Locality served	Target operating speed (km/h)	Min. road width (m)	Max. grade	Pedestrians	Passing, parking, loading, and shoulder	Cyclists	Movement lane (excluding shoulder)	Classification		
Notes	See 3.2.4, table 3.1 & 3.3.1.6	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.5, 3.3.7, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Work and learn	Primary access to office and education	1 to 200 lots	30	20	10%	3.5 m each side	Parking and loading bays may occur in the movement lane or be separate and recessed. See 3.3.6	Shared (in movement lane)	5.5 - 5.7	Local road (~ 2,000 vpd)		E29
	Mixed use	Multiple user access	1 to 200 lots	30	20	10%	3.5 m each side	Parking and loading bays may occur in the movement lane or be separate and recessed. See 3.3.6	Shared (in movement lane)	5.5 - 5.7	Local road (~2,000 vpd)		E30

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4, table 3.1 & 3.3.1.6	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.5, 3.3.7, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
Urban	**Mixed use**	Neighbourhood centres (and all other areas serving multiple land uses not listed elsewhere in this table)	200 to 800 lots	50	23	10%	2.5 m each side	Parking is preferred separate and recessed. See 3.3.6. Public transport is likely (see 3.3.1.4, 3.3.1.5)	Separate provision where local authority defined cycle route.	2 x 4.2	Connector/collector (~ 8,000 vpd)		E31
Centre	**Mixed use**	Side or rear service access	1 to 20 lots	10	6	16%	Shared (in movement lane)	Parking and loading bays (shared in movement lane). See 3.3.6	Shared (in movement lane)	5.7	Lane (~ 200 vpd)		E32

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4, table 3.1 & 3.3.1.6	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.5, 3.3.7, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Mixed use	Access to lots or mixed use activities	1 to 20 lots	20	11	12%	Shared (in movement lane)	Parking and loading bays may occur in movement lane or be separate and recessed. See 3.3.6	Shared (in movement lane)	5.5 - 5.7	Lane (~ 200 vpd)		E33
Centre	Mixed use	Primary access and local movement	1 to 200 lots	30	20	10%	2.5 m each side	Parking and loading bays may occur in movement lane or be separate and recessed. See 3.3.6	Shared (in movement lane)	5.5 - 5.7	Local road (~ 2,000 vpd)		E34

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4, table 3.1 & 3.3.1.6	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.5, 3.3.7, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Mixed use	Shared spaces, accessway, mall, and community reserve	Varies, specific design required	10	11	None if steps	Shared (in movement lane)	Activity space	Shared (in movement lane)	2.75 - 3.00 vehicle movement space, total space by design	Local road (~ 2,000 vpd)		E35
	Mixed use	Urban street	200 to 800 lots	40	23	10%	4.0 m each side	Parking and or loading is separate and recessed. See 3.3.6. Public transport is likely (see 3.3.1.4, 3.3.1.5)	Where local authority defined cycle route	2 x 4.2	Connector/col lector (~ 8,000 vpd)		

Table 3.2 (continued)

3.3.3 Pavement structural design

Generally pavements shall be flexible designs. Other types of pavements shall be subject to TA approval. Pavements shall be designed in accordance with the Austroads guides with a design life of 25 years.

Where applicable the assessment of Equivalent Standard Axels (ESA) shall include a growth rate of 6% per annum for any existing traffic loading.

> ***C3.3.3***
>
> *For roads of connector/collector class or above, structural design should be undertaken by mechanistic design methods. For other roads, mechanistic or other industry standard chart based methods may be used.*

3.3.3.1 California bearing ratio design method for rigid and flexible pavements

Soaked California bearing ratio (CBR) values of the pavement subgrade shall be used and the pavement designed for the estimated number of equivalent standard axle (ESA) loadings over a 25-year design life.

3.3.3.2 California bearing ratio tests

CBR values shall generally be determined in the laboratory according to 6.1 of NZS 4402.6.

—For local roads an alternative method of determining subgrade CBR in non-granular materials by Scala Penetrometer may be acceptable for clay and colluvial materials.

Figure 3.1 shows a correlation between Scala penetration and CBR values. This should be used conservatively.

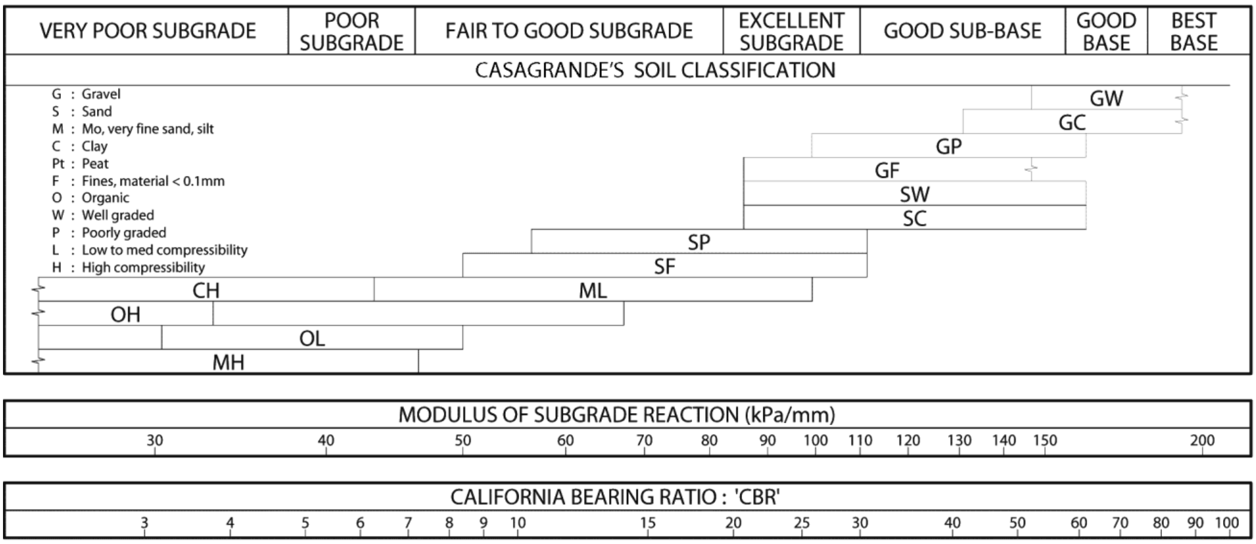
The CBR value used in the design shall be the 10th percentile value of the CBR tests taken on the subgrade material. A selection of tests shall be taken at 150, 300, and 450 mm below final subgrade level.

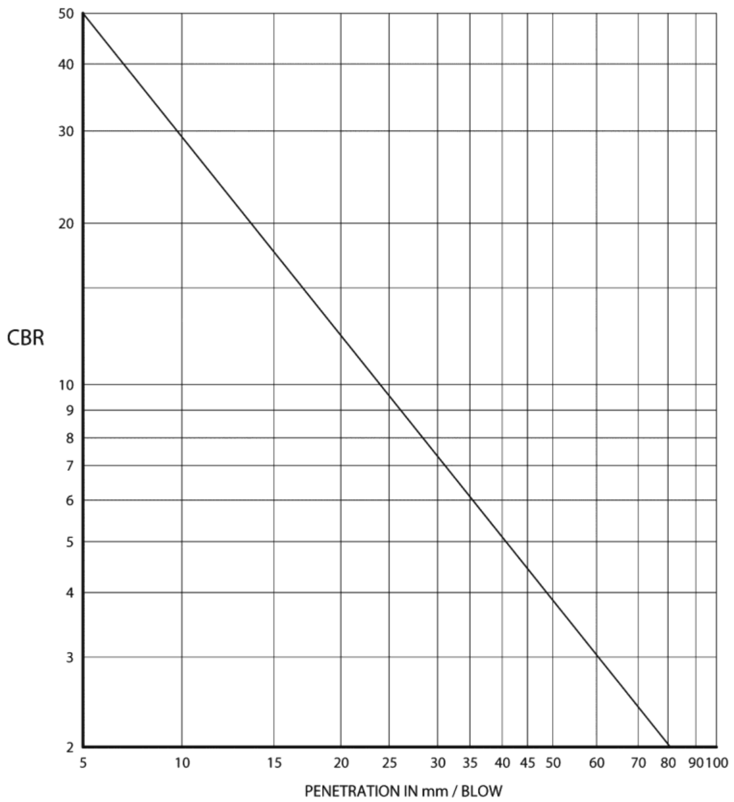
Where CBR values are required for aggregates, these shall be based on laboratory tests prepared on the fraction passing the 19 mm sieve but a CBR of more than 30 shall never be used. The use of CBR on metal layers shall only be in conjunction with consideration of the CBR and stiffness of lower layers.

The use of Scala Penetrometer to determine the CBR value on local roads with clay and colluvial materials shall be approved by the Council at its sole discretion.

And

CBR values shall be determined by an IANZ (International Accreditation New Zealand) accredited laboratory. Details of the CBR values determined, together with certification by the accredited laboratory shall be submitted for approval by Council prior to the issue of a certificate in accordance with clause 224(c) of the Resource Management Act 1991.





CORRELATION OF DYNAMIC CONE mm PER BLOW AND
CALIFORNIAN BEARING RATIO
(SCALA PENETROMETER)

Figure 3.1 – Parameter relationship

3.3.4 Safety barrier provisions

Where roads, private ways or other vehicular or pedestrian access, whether public or private, run parallel with land which drops away to a height of greater than 1.0m at an angle of greater than 45 degrees within 2.0m of the edge of the road or footpath, the side shall be provided with safety barriers to protect pedestrian and vehicular traffic.

3.3.4.1 Pedestrian and cycle barriers

Where safety barriers for pedestrian and cyclists are necessary, they shall comply with the design requirements of the New Zealand Building Code and NZS/AS 1657.

3.3.4.2 Urban vehicle barriers

Where safety barriers for vehicles in urban areas are necessary, they shall comply with the design requirements of NZTA RTS 11: *Urban roadside barriers and alternative treatments*.

3.3.4.3 Rural vehicle barriers

Where safety barriers for vehicles in rural areas are necessary, they shall comply with the design requirements in AS/NZS 3845.

3.3.5 Target operating speed

Traffic management shall be included in road design to ensure that the target operating speed shown in table 3.2 is achieved. Target operating speed can be managed by physical and psychological devices such as narrowed movement lanes, reduced forward visibility, parking, slow points, build outs, leg lengths, chicanes, planting and landscaping, and street furniture and art works.

The Austroads *Guide to traffic management* – Part 8: *Local area traffic management* provides suitable guidance for designing to a target operating speed. Reference can also be made to the *Manual for streets* (UK Department for Transport 2007). Figure 3.2 provides information on estimating traffic speeds for particular circumstances.

C3.3.5

The two key geometric factors that contribute to achieving the target operating speed are carriageway width and forward visibility. Figure 3.2 can be used to give an indication of the speed at which traffic will travel for a given carriageway width/forward visibility combination. (Reference: UK Department for Transport, 'Manual for streets'. Figure 3.2 is adapted from figure 7.16 in the reference and 'TRL661 – The manual for streets: evidence and research'). It is recommended that the user interpolate the design street width between the guide lines shown to determine relative street width and forward visibility.

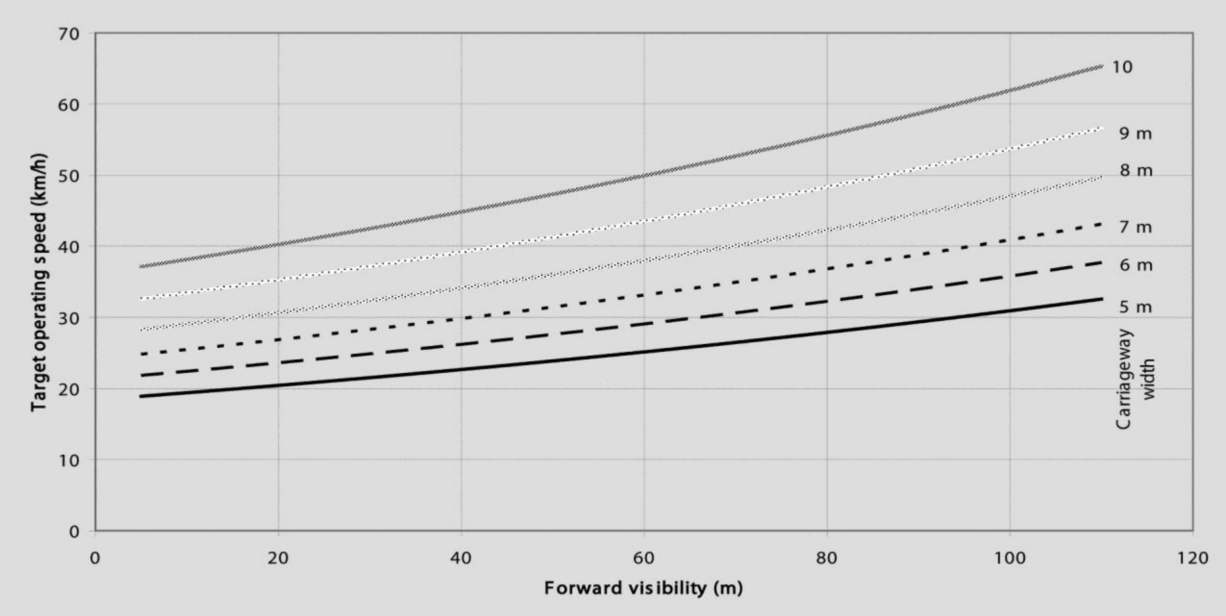


Figure 3.2 – Influence of road geometry on speed

3.3.6 Parking, passing, and loading

Parking and loading can be provided either on or off-street. Facilities shall meet the needs of the area and the requirements of the TA, and shall be addressed in the design and access statement (see 3.2.6). Further guidance can be found on the Trips Database Bureau website http://www.tdbonline.org/home.

Passing provision shall be in accordance with the design guidance in table 3.2 and the requirements of the TA.

Acceptable and alternative on-street car park and loading dimensions should be taken from AS 2890.5 and/or the Austroads guides.

Parking and loading shall not be provided so that it has the potential to obstruct the movement of emergency or service vehicles along a road. Alternate provision within sites may be demonstrated in addition to the requirements of the district plan, particularly when establishing rules for new subdivisions.

All indented parking bays shall be designed and constructed to avoid sharp corners. Corners shall be designed and constructed with adequate radiuses to allow for cleaning by street cleaners utilising rotary brushes.

3.3.7 Intersection and alignment design

The angle of intersection should be 90°, although a minimum angle of 70° can be used when justified by other constraints. Carriageway alignment may be offset within the street reserve to achieve the required target operating speed for the road.

All road intersections in ‘live and play’ areas below arterial class should have a kerb radius at intersections of 4 m to 6 m. An alternative and reduced kerb radius may be considered to enhance pedestrian facility in low speed environments, and shall be subject to the approval of the TA.

All intersections in 'make and grow' areas should have a minimum kerb radius of 13.5 m with corner splays of 6 m, or subject to specific design.

Intersections in all other 50 km/h or lower speed environments shall have the lot corners splayed by a minimum of 4 m along both boundaries, although these may be dispensed with in low target operating speed situations provided that there is adequate provision for pedestrians and utility services. Corner boundary splays shall be subject to specific design in higher speed environments, to ensure safe visibility at intersections.

Reference can also be made to Austroads guides.

Intersections between connector/collector roads or intersections of connector/collector roads with arterials shall be a minimum distance of 150 m apart, centre line to centre line.

3.3.8 No-exit roads

'No-exit' roads should not be provided where through roads and connected networks can be designed. Where no-exit roads are provided, they should ensure connectivity for pedestrians and cyclists.

No-exit roads and lanes shall provide for road turning at the end of the road for an appropriate vehicle as described in *RTS 18: New Zealand on-road tracking curves for heavy vehicles*. The design of turning facilities for light vehicles shall be in accordance with AS 2890.5. See figures 3.3 and 3.4 for acceptable solutions.

An on-road turning area may provide for parking or landscaping in the centre of the turning area. The minimum kerb gradient around turning heads shall be 0.5%. Appropriate drainage shall be provided.

Areas required for turning shall be suitably marked to maintain access and prevent parking from blocking the turning area. Markings shall be in accordance with clause 3.3.12

3.3.9 Bus stops

Bus stops shall be provided for on connector/collector roads or arterials in accordance with the TA direction in consultation with the regional transport authority. Bus stops may be designed in accordance with ARTA *Bus stop infrastructure design guidelines.*

3.3.10 Special road and footpath provisions near places of assembly

Designs for areas adjacent to places of public assembly including schools, hospitals, shopping areas, and public halls, shall incorporate special provisions such as extra parking spaces, stopping lay-bys, widened footpaths, bus and taxi stops, pedestrian crossings, loading zones, and any associated facilities to ensure the safety of concentrations of vehicles and pedestrians.

3.3.11 Footpaths, accessways, cycle paths, and berms

Pedestrians, cyclists, and berms shall be provided for in accordance with table 3.2. Dimensions, strength, durability, and finish shall be appropriate to their use and expected loadings. Paths shall be designed in accordance with Austroads guides and NZTA *Pedestrian planning and design guide.*

Where accessways separate from the roads are to be illuminated, they shall be to the standard of illumination recommended in AS/NZS 1158.3.1.

3.3.11.1 Footpaths and accessways

Footpaths shall be a minimum of 1.5 m wide surfaced over their full width. The crossfall should be no greater than 2%. Wider footpaths or areas of local widening will often be required by the TA where higher use or other needs dictate such widening.

Accessways should be provided at no-exit roads or where necessary to improve connectivity. They shall be designed for user safety using crime prevention through environmental design (CPTED) principles and should:

(a) Be direct and no greater than two properties long;

(b) Have good sight lines for passive surveillance with fences a maximum height of 1.2 m for 10 m from the road frontage, or no fencing;

(c) Be sited to ensure high levels of community use;

(d) Be amenity landscaped without compromising safety;

(e) Have provision for the disposal of stormwater;

(f) Be provided with pedestrian level lighting; and

(g) Have a legal width not less than 5.5 m.

3.3.11.2 Cycle paths

Separate cycle paths shall be provided where good design requires separation from the carriageway or a different route to be selected.

Stormwater disposal shall be provided to all off-road cycle paths. Lighting is to be provided where appropriate.

Cycle facilities shall be designed to the standards as set out in the Austroads guides and the NZTA *Cycle network and route planning guide.*

3.3.11.3 Footpath and cycle path surfacing

All footpaths and cycle paths shall be surfaced with a permanent surfacing layer appropriate to the surrounding environment and level of use expected.

Acceptable surfacing for footpaths and cycle paths are:

(a) Concrete;

(b) Asphaltic concrete.

Other acceptable surfacing for footpaths are:

(c) Concrete pavers;

(d) Other pavers may be approved by a TA in areas of high aesthetic value;

(e) Chipseal (grade 6) may be approved by a TA in areas of very low pedestrian traffic;

(f) Metal surfaces may be appropriate in rural areas;

(g) Permeable or porous paving may be approved by a TA.

In all cases the surfacing shall be placed over compacted basecourse which in turn shall be placed over a firm subgrade with all organic soft material removed.

3.3.11.4 Berms

Grassed or planted berms between the road legal boundary and carriageway shall be provided in accordance with the landscape character intent for each street type within the development. For streets with high pedestrian activity, a full footpath (with no berms) may be more appropriate. Residential streets with a lower pedestrian activity may have a ribbon footpath (planted berms between footpath and carriageway, and between footpath and road boundary).

In all cases the combined berm and footpath width shall be as required by the TA to be adequate to enable landscaping and all current and expected services to be installed.

Where a berm crossfall greater than 1 in 12.5 is proposed, the designer shall produce a cross section along suitable individual property access locations to show that the sag or summit curves at crossings can be satisfactorily negotiated by a 90th percentile car.

Berms shall be of adequate width to:

(a) Achieve safe clearances between the carriageway edge and any obstacle;

(b) Allow running of utility services and placing of lighting poles within the berm unless approved otherwise by the utility provider or the TA;

(c) Provide adequate space between the road reserve boundary and the carriageway edge to enable residents to safely enter the road traffic;

(d) Allow room for efficient road edge and edge drain maintenance; and

(e) Allow adequate space for the effective operation and maintenance of any form of stormwater management device.

3.3.12 Traffic signs, marking, and road furniture

The design shall incorporate all required road marking, signs, and other facilities appropriate to the place and link context. Roads should be designed to minimise the need for traffic signs and marking.

Designs shall satisfy the Land Transport Rule (Traffic Control Devices) 2004 and linked traffic sign specification, and the NZTA *Pedestrian planning and design guide.* All road markings and traffic signs shall be approved by the TA.

All fire hydrants shall be marked in accordance with NZS/BS 750.

Road name signs shall comply with the TA’s current road names standards and their mounting shall be provided by the developer to the TA’s requirements.

Seats, signs, and other street furniture shall be designed and placed in accordance with the TA’s requirements. Furniture used should unless expressly approved otherwise be compatible with a TA’s existing street furniture.

Reflective raised pavement markers shall not be used to provide for road marking or to identify fire hydrants.

3.3.13 Trees and landscaping

See section 7 of this Code of Practice.

3.3.14 Road lighting

All road lighting shall be designed and installed in compliance with the recommendations of AS/NZS 1158, Austroads guides or guidelines adopted by the TA at that time.

All road lighting to be vested to the Council shall be LED unless agreed in writing by the Council's Asset Performance Team
And
All luminaires shall be selected from the NZTA M30 accepted luminaires list
And
All road lighting assets including but not limited to columns, lamps and mountings shall be approved by Council's Asset Performance Team
And
All lighting required to provide illumination for vested assets and external areas which are accessible to the public shall have a minimum rating of IP65
And
All lighting shall comply with the intent of the Southern Lighting Strategy.

3.3.15 Bridges and culverts

Bridges and culverts may require separate resource and building consents. All bridges and culverts shall be designed in accordance with the NZTA *Bridge manual.*

Particular features to be considered/covered include:

(a) Widths/lengths:
All bridges and culverts shall be designed with a width to accommodate movement lane, cycle, and pedestrian needs of the road (see table 3.2);

(b) Roadside barriers:
See 3.3.4;

(c) Batter slope protection:
All culverts shall have anti-scour structures to protect batter slopes, berms, and carriageways;

(d) Clearance over traffic lanes:
Where passing above traffic lanes, bridges shall have the full clearance of 5.2 m to provide clearance for overdimension vehicles able to operate without a permit;

(e) Foundations:
All bridges and culverts shall be founded to resist settlement or scour. Abutments shall be designed to ensure bank stability and provide erosion or scour protection as applicable;

(f) For waterway design see section 4.

3.3.16 Private ways, private roads, and other private accesses

Access to all lots, dwellings, or multi-unit developments shall be considered at the time of subdivision/development and should where possible be formed at that time.

Where access to the lot is to a garage or car deck to be constructed as part of the buildings this shall be noted on the design drawings. This is likely to have been considered as part of the resource consent process.

Accesses shall be designed and constructed to the following requirements or in accordance with the TA's specific requirements, unless alternative designs by the developer's professional advisor are approved by the TA.

3.3.16.1 Plan and gradient design

Table 3.2 should be used as a guide for the widths of elements required for accesses.

A maximum 3-point turning head in the common area shall be provided at the end of all accesses serving three or more rear lots or dwelling units. Circular, L, T, or Y shaped heads are acceptable. Suitable dimensions are shown in figures 3.3 and 3.4.

For accesses serving fewer than three lots or dwelling units, turning heads in the common area are not required where it can be shown that adequate turning area is available within each lot or private area.

Centre line grades should:

(a) Not be steeper than 1 in 5 although gradients of 1 in 4.5 may be used on straight lengths of access over distances of up to 20 m. The first 5 m of any access shall be not steeper than 1 in 8. A greater length of transition shall be provided where necessary on non-residential accesses;

(b) Not be less than 1 in 250.

> ***C3.3.16.1 (a) and (b)***
>
> *The TA may approve exceptions provided the design includes suitable vertical transitions and adequate safety at the point where the access meets the footpath or road.*

All accesses shall be shaped with either crown or crossfall of not less than 2%.

To allow vehicles to pass, accesses shall have widening to not less than 5.5 m over a 15 m length at not more than 50 m spacing. Rural accesses may have passing bays at up to 100 m distances where visibility is available from bay to bay.

3.3.16.2 Stormwater design

All shared urban accesses shall be surfaced and have their edges defined by a structural edge. The design shall demonstrate consideration of a sustainable approach to stormwater management rather than kerbed collection, channelling, and disposal, if possible.

Rural accesses shall be formed with safe water tables/edge drains along but adequately clear of each side of the access.

Accesses sloping up from the road shall have a stormwater collection system at the road reserve boundary so as to avoid stormwater run-off and debris migration onto the public road. Except in rural areas, stormwater shall discharge via an appropriately sized and designed stormwater system acceptable to the TA (see figure 3.8 for examples of typical sump to driveway or right of way). Rural side drains may discharge directly to the roadside drain or where accesses pass over the side drain they shall be provided with a culvert of size appropriate for the design flow but not less than 300 mm diameter.

Accesses that slope down from the road shall be designed to ensure that road stormwater is not able to pass down the access. Side drainage in context with the area shall be provided to stop the concentration and discharge of stormwater and debris onto adjacent properties or any land which could be at risk of instability or erosion. Where an overland flow path departs from the road reserve, accesses shall be designed to direct secondary flow away from building floors and to follow designed overland flow paths.

Commercial and industrial accesses shall drain from their sumps through a lead directly or through a stormwater treatment device to a public stormwater main.

3.3.16.3 Pavement design

Private pavements shall be designed as for public roads but no residential or rural pavement shall have a minimum formation thickness of less than 150 mm for flexible pavements or 100 mm for concrete pavements.

Commercial and industrial pavement shall be provided with adequate supporting design to ensure that it will have a life of 20 years.

Acceptable surfacing for accesses includes asphaltic concrete (25 mm minimum thickness), chipseals, in situ concrete or concrete pavers.

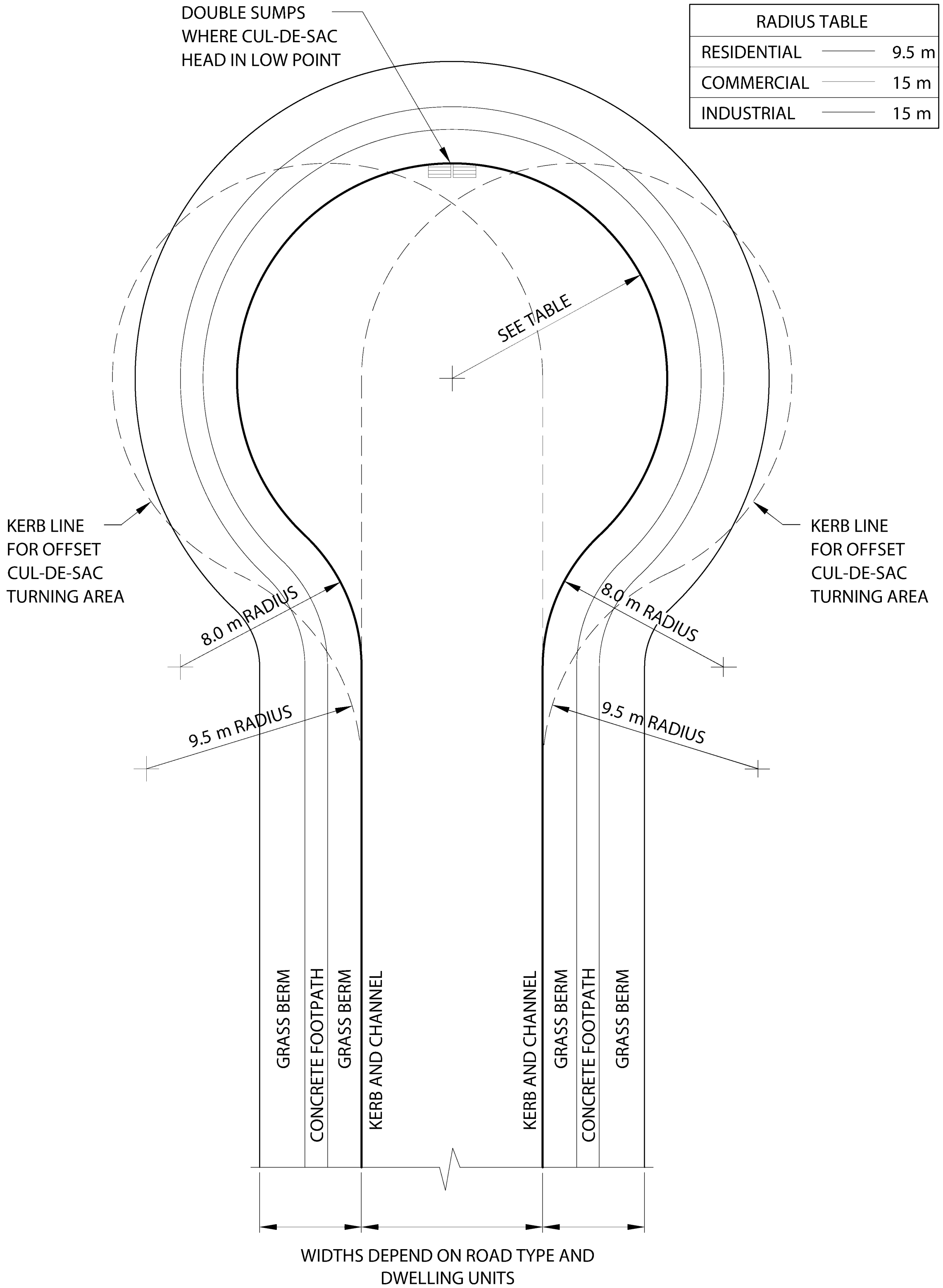


Figure 3.3 – Dimensions of no-exit road turning areas

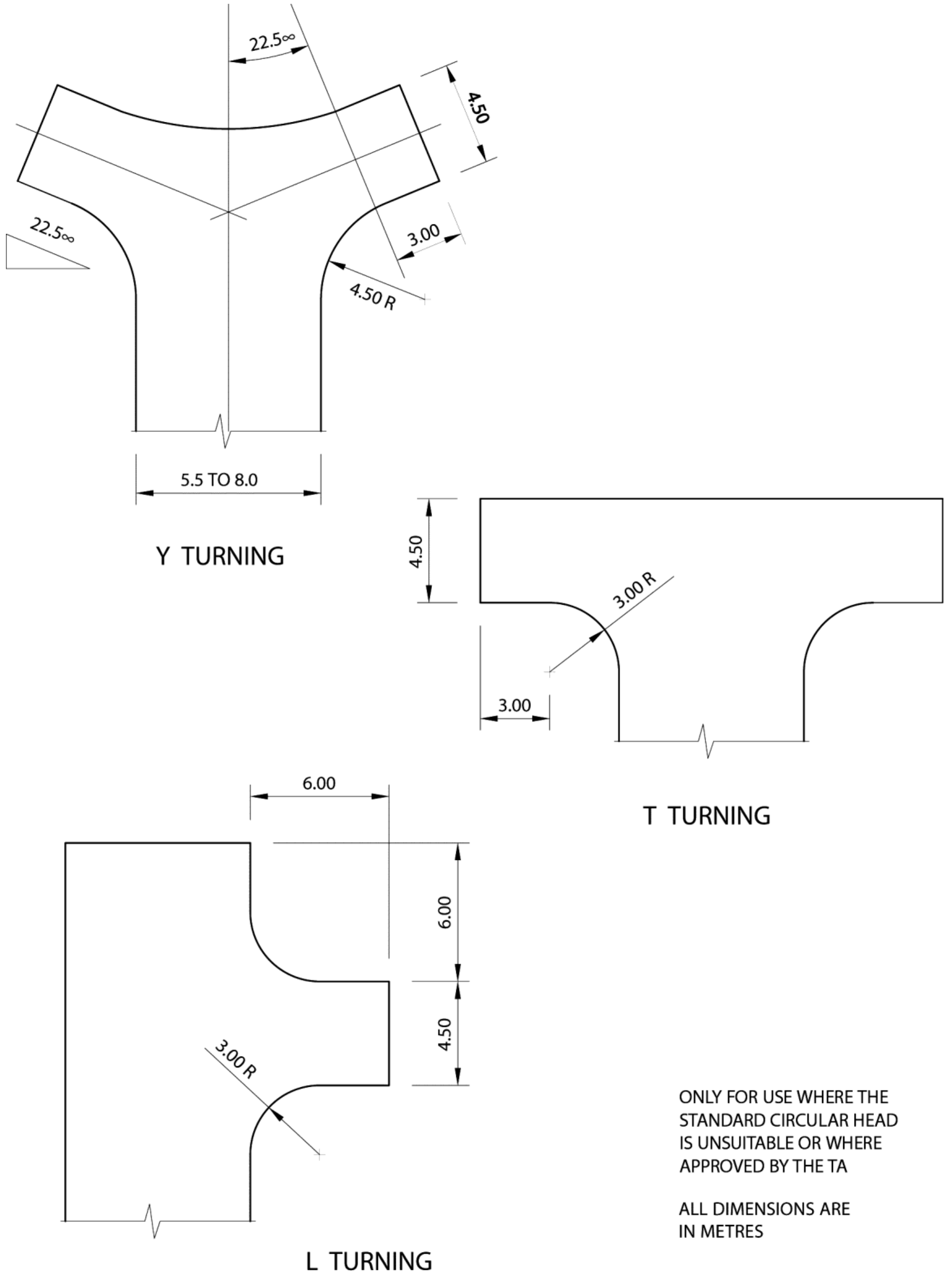


Figure 3.4 – Turning areas for no-exit roads

3.3.17 Crossings

3.3.17.1 Urban

Vehicle crossings shall be provided between the edge of the movement lane and the road boundary at the entrance to all private ways and lanes and to any lots, front or rear where access points are clearly identifiable at the subdivision or development stage.

Where access points are not clearly identifiable at the subdivision or development stage, crossings shall be constructed at the building consent stage.

Vehicle crossings shall be designed to enable the 99th percentile car to use them without grounding any part of the vehicle, and shall be designed in accordance with the NZTA *Pedestrian planning and design guide*. Structural design shall be adequate to carry the loads to be expected over its design life. All crossings shall be surfaced with asphalt or concrete or paving stone as approved by the TA.

Crossings shall be in accordance with diagrams contained in appendix E.

Where stormwater drainage is provided by swale or open drain, crossings shall be provided as specified in 3.3.17.2.

Pram and wheelchair crossings shall be provided at all road intersections and pedestrian crossings. The crossings shall be sited to facilitate normal pedestrian movements in the road and where possible sumps shall be sited so as to reduce the flow of stormwater in the channel at the crossing entrance. Pram and wheelchair crossings shall satisfy the NZTA *Pedestrian planning and design guide.*

3.3.17.2 Rural

All shared crossings and any where the location is obvious at the design stage shall be installed at the development stage. Other crossings shall be provided at the building consent stage.

Crossings shall be provided between the surfaced road edge and the lot boundary at a defined and formed access point to every rural lot. The crossing shall be sealed to not less than the standard of the road surface and to the road boundary. If the access slopes up from the road the crossing shall be sealed to a minimum distance of 10 m from the edge of the carriageway.

The crossing shall not obstruct the side drain. Where the side drain is shallow and only carries small flows during rain, the crossing may pass through the side drain. Where the side drain is of an unsuitable shape or carries flows for significant parts of the year the side drain shall be piped under the crossing. Pipes and end treatments shall be sized appropriately for the catchment intercepted but shall be a minimum of 300 mm diameter.

Rural crossings shall be designed so that vertical curvature transitions are suitable for the passage of the 99th percentile car and control of stormwater and debris run-off.

3.3.18 Fencing

Fencing shall be provided along the road reserve boundaries of all rural subdivisions unless agreed otherwise by the TA. Standards and requirements shall be in accordance with the TA's fencing policy at the time. This shall also apply to fencing of pedestrian, cycle, and reserve accesses in rural areas.

3.3.19 Road run-off

3.3.19.1 Integration of road run-off with development stormwater system

Stormwater management for a subdivision needs to integrate the control of stormwater from the proposed roading network with the overall stormwater system for the land development phase and final subdivision layout. Such planning needs to integrate the control of stormwater peak flows and pollutant removal as set out in section 4 of this Code of Practice with the aim of minimising downstream negative effects and mitigating road instability and erosion problems. Some guidance on integrated catchment management is set out in NZTA *Stormwater treatment standard for state highway infrastructure*.

3.3.19.2 Design

For stormwater run-off design see section 4 of this Code of Practice.

3.3.19.3 Subsurface drains

Where considered necessary by the TA or the developer's professional advisor, piped subsurface drainage shall be provided to protect road formations from deterioration or loss of strength caused by a high water table and as part of swale stormwater systems. Design shall be in accordance with NZTA specification F/2.

Piped subsurface drains shall be provided on each side of all urban roads where the natural subsoils have inadequate permeability or unacceptably high water table to enable long term strength of the new pavement to be maintained. Piped subsurface drains shall be provided on the upslope side of all urban roads in hill areas and on the down side also where the down slope is in cut.

All piped subsurface drains shall discharge by gravity into a suitable component of the public stormwater system or approved discharge point.

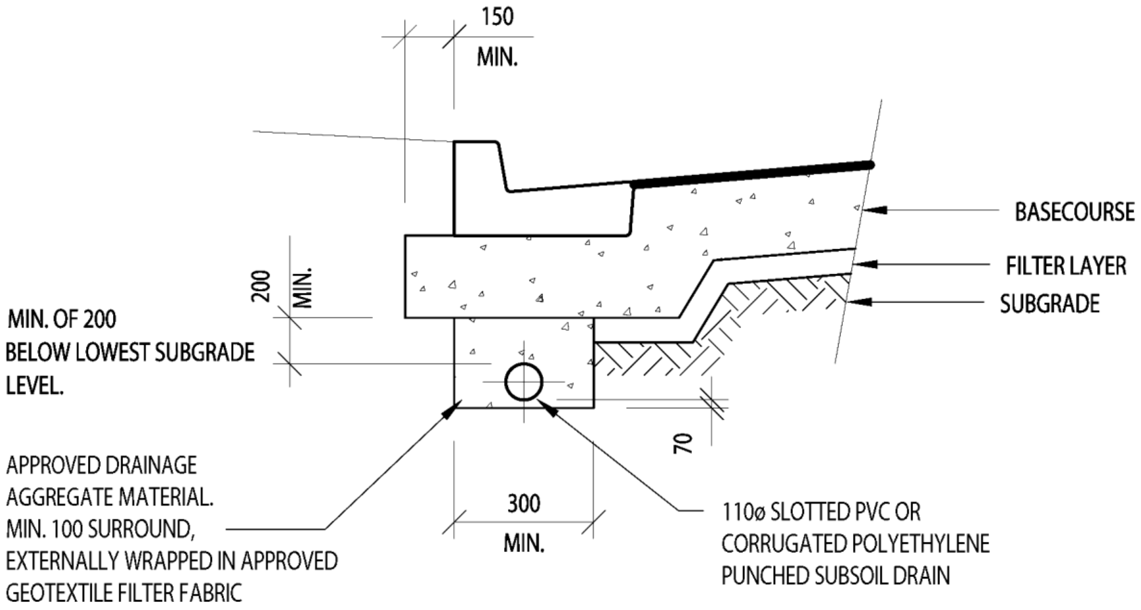
For two typical details of under-kerb drainage and subsoil drainage see figure 3.5.

3.3.19.4 Side drains/water tables

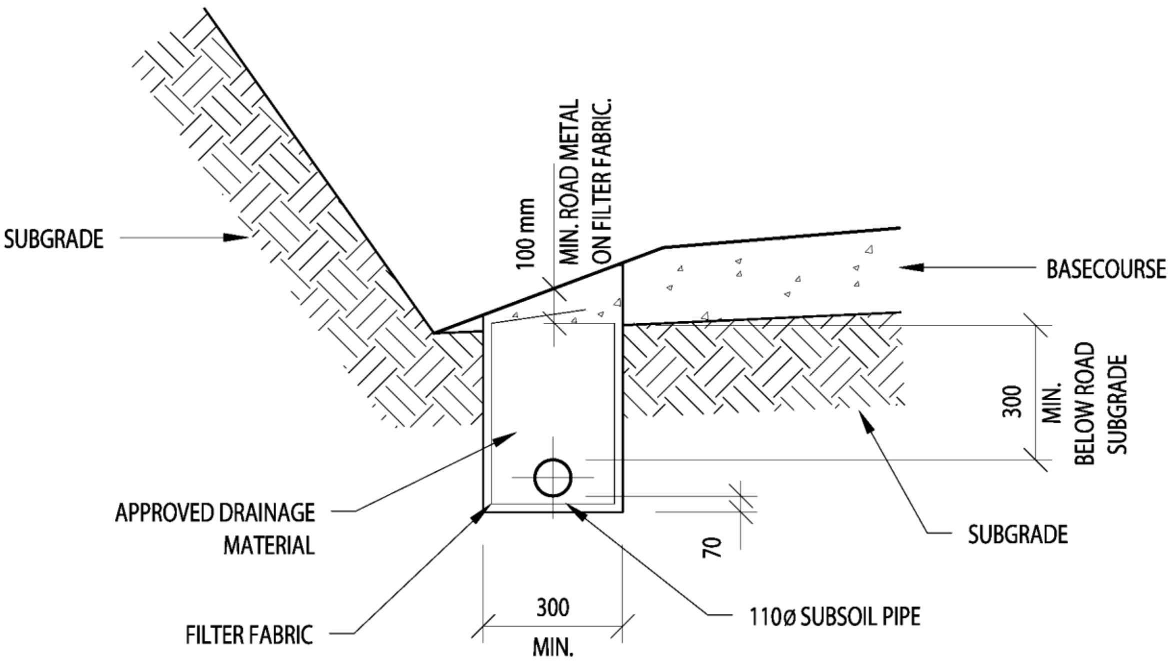
Rural roads shall have normal camber (see table 3.2) to side drains/water tables formed on each side of the carriageway except where the road is on embankment above adjacent land without available formed drains. In such cases the road may be designed so as to provide for sheet run-off to the adjacent land surface provided natural pre-existing drainage patterns are not altered.

For all situations where side drains are required they shall be sized to suit the flows discharging to them. Side drains shall be intercepted at regular intervals and discharge via open drains or pipes to an appropriate discharge point. All discharge points shall have outlets protected from scour and shall be located to minimise the risk of slope instability.

Such discharges shall be subject to the approval of affected property owners and be shown to be neither diverting catchments nor significantly changing peak flows or flow patterns.



UNDER KERB DRAINAGE



SUBSOIL DRAINAGE

All dimensions are in millimetres.

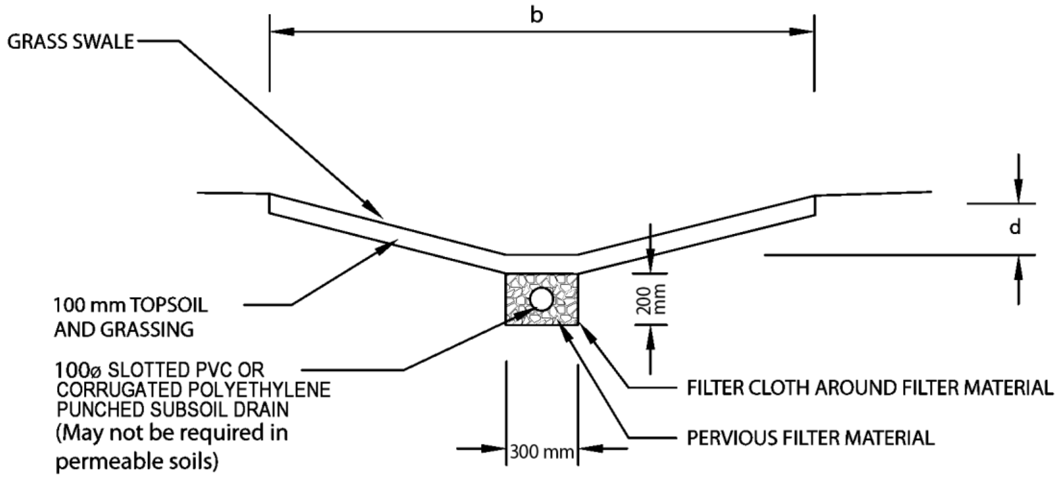
Figure 3.5 – Subsoil drains

3.3.19.5 Swales

Swales should be used wherever appropriate to allow for infiltration to reduce peak discharge flows and to provide stormwater treatment. They can be located either in the berm area or in the centre of the road, and must be of sufficient width to accommodate services (if needed), plant growth and maintenance (see 7.3.5).

Where swales are used they shall be designed by a suitably qualified person in accordance with TA requirements or one of the publications listed in Referenced Documents or Related Documents that cover swale design. Typical details that may be used in swale design are shown in figures 3.6(A) to 3.6(C).

See 4.3.7.6 for swale design and section 7 on landscaping design and practice.

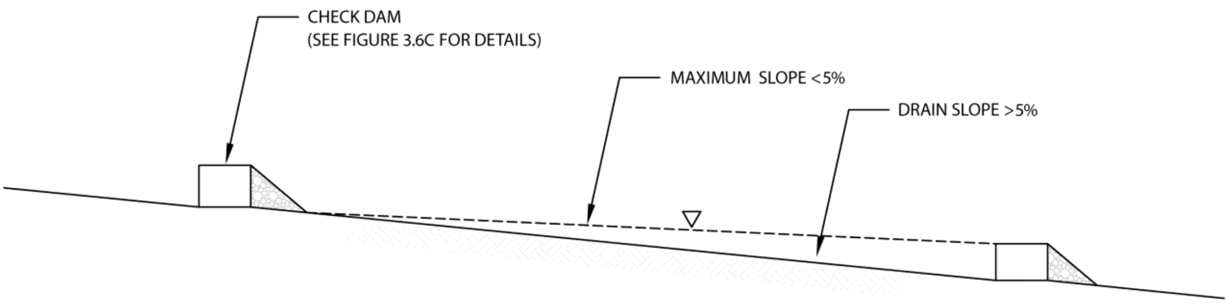


SWALE CROSS SECTION

NOTE –

1. Effective catchment area drained = impervious area + 0.72 x pervious area.
2. Maximum swale slope up to 5%. Steeper swales require check dams (see figures 3.6(B) and 3.6(C)).
3. Dimensions 'b' and 'd' to be sized for conveyance of 10% AEP event.
4. Existing ground is regraded, compacted, topsoiled (100 mm depth), and grassed.
5. Side slopes no steeper than 1v:3h if planted (not mown).
6. Side slopes no steeper than 1v:5h if grassed (mown).

Figure 3.6(A) – Typical swale detail (1)



LOCATION OF CHECK DAMS IN SWALES

Figure 3.6(B) – Typical swale detail (2)

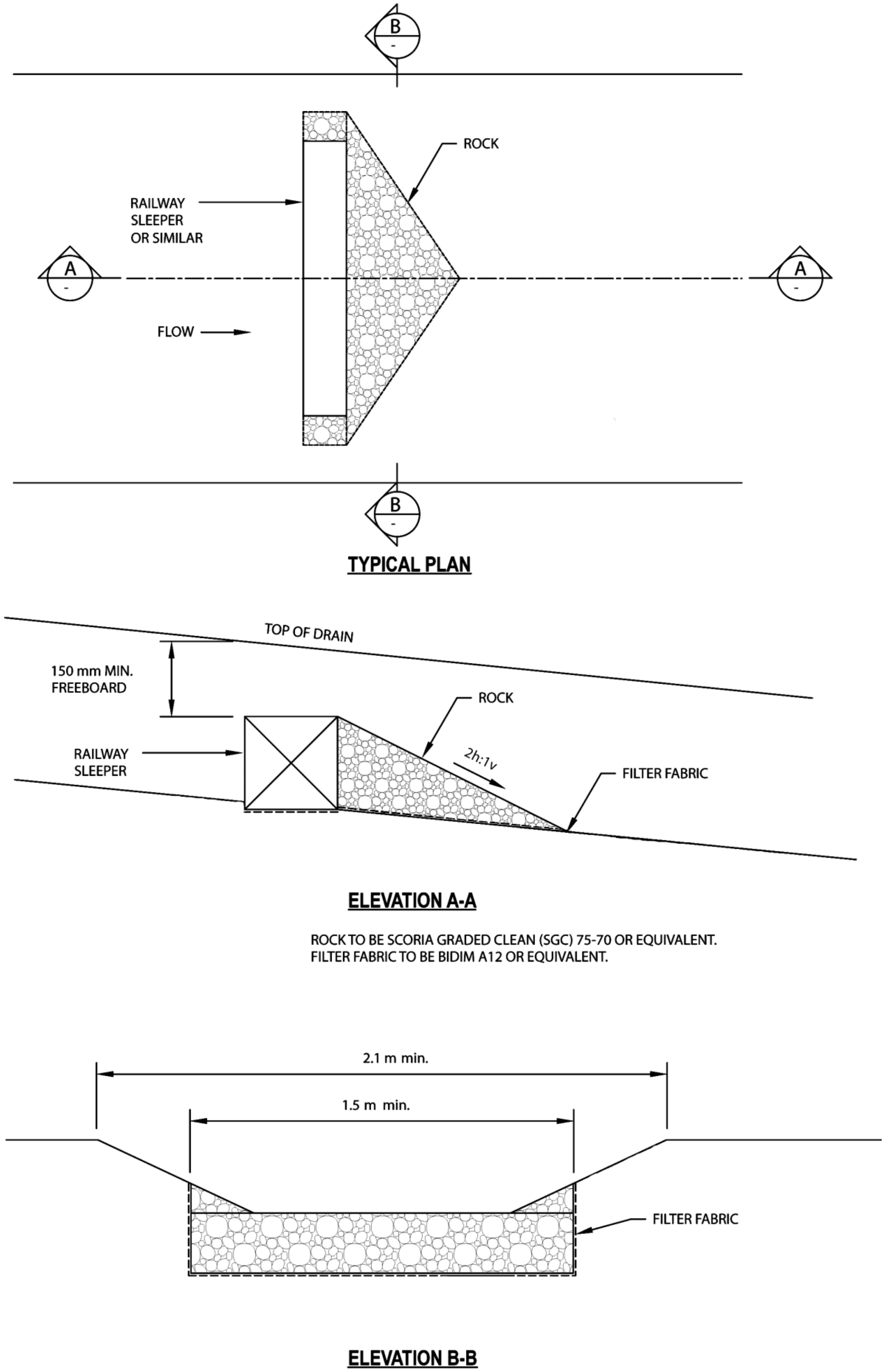


Figure 3.6(C) – Typical check dam detail

3.3.19.6 Kerbs and channels

Where kerbs and channels are to be provided on carriageways they should comply with figure 3.7. Mountable or nib kerbs, or their slip-formed equivalent may be used subject to the approval of the TA. Pedestrian crossings (pram crossing) should be provided for disability access at regular intervals and at locations where pedestrians are reasonably expected to transition between footpaths and the street.

When their installation is approved mountable kerbs shall be “Kerbmaster No8” profile.

3.3.19.7 Sumps

Sumps used in all public places shall comply with the TA’s current standard details.

Stormwater sumps are classified as three types according to the design of their inlets:

(a) Grated only inlet sumps: Grated inlets are effective in intercepting gutter flows. They also provide access openings for maintenance. Grated inlets are prone to blockage and problems of increased pavement maintenance in the immediate vicinity of the inlet, therefore, their use in street gutters are discouraged. They are suitable for non-kerbed situations such as yards, end of ditches, open car parks, accessways, driveways, medians, and ponding areas. Figures 3.8 and 3.9 show details of common types of grated inlet;

(b) Back entry inlet sumps: Back entry inlets are less affected by blockage, and they are more effective in intercepting flows in sag areas;

(c) Combined grates and back entry inlet sumps: This system of combining a back entry with the traditional grated inlet significantly improves flow intake and is less prone to blockage from debris. This type of inlet should be used in all situations where possible. Figures 3.10 to 3.14 show typical examples of this type of inlet.

Figure 3.8 shows an acceptable detail for sumps in accessways, footpaths, and rights of way. A flat channel or yard sump and various styles of hillside sump are shown in figures 3.9, 3.10, 3.11, 3.12, and 3.13.

A double back-entry sump for road low points is shown in figure 3.14.

All grates shall be of a design that are cycle friendly. Grate slots shall not run parallel to the direction of carriageway travel.
And
The invert level of all sump chambers shall be greater than 500mm below the invert level of the outlet pipe.
All sumps shall incorporate a siphon or alternative solution acceptable to the Council

3.3.19.7.1 Sump location

Sumps shall be located:

(a) To ensure that the total system design flow enters the pipe system and that surface flows across intersections are minimised. In hill areas the total design flow shall include run-off from any upslope hillsides that are not specifically drained. In many cases this will mean the use of closely spaced or specially designed sumps to ensure that the flow to which the pipe system is designed can actually get into the system;

(b) At all points in a surface system where a change in gradient is liable to result in ponding due to change in flow velocities or on bends where there may be a tendency for water to leave the kerb and channel;

(c) Not further apart than 90 m along any surface system.

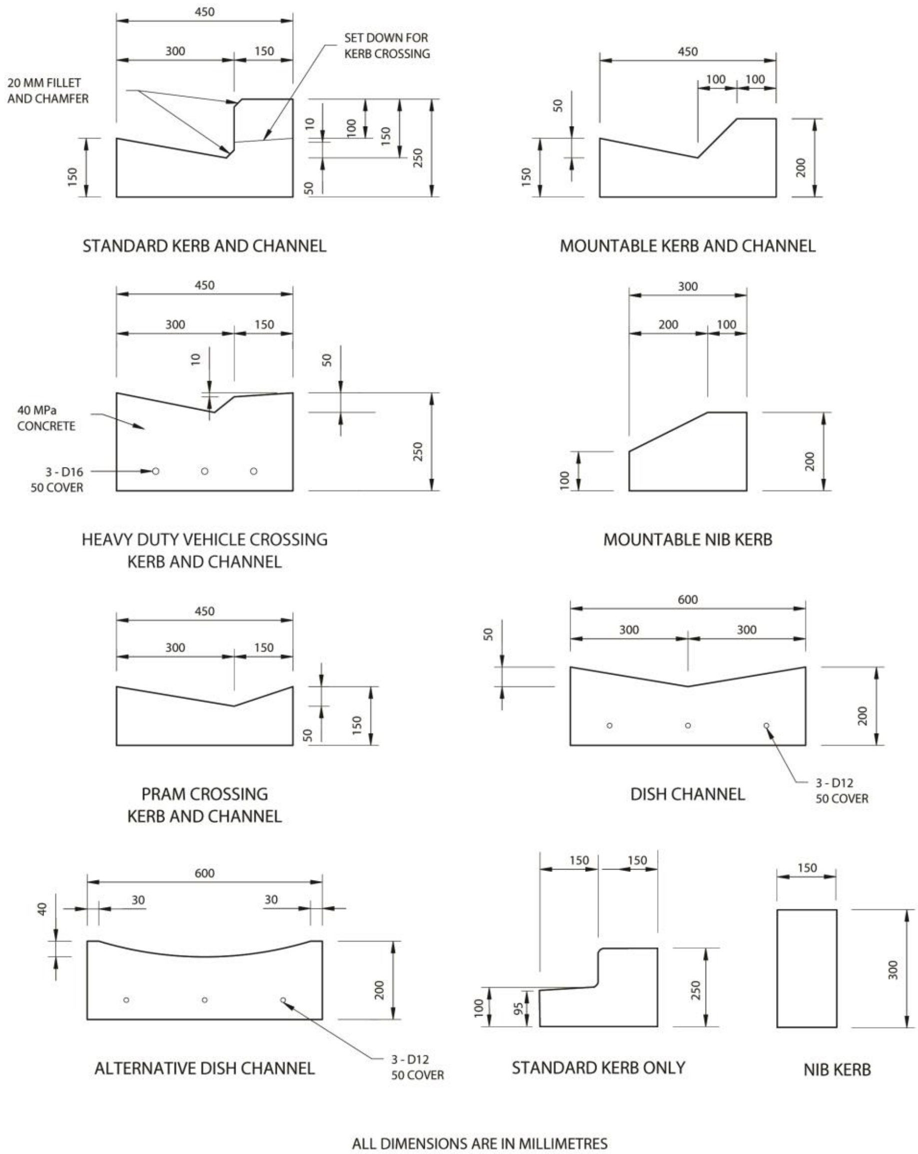


Figure 3.7 – Kerbs and dished channels

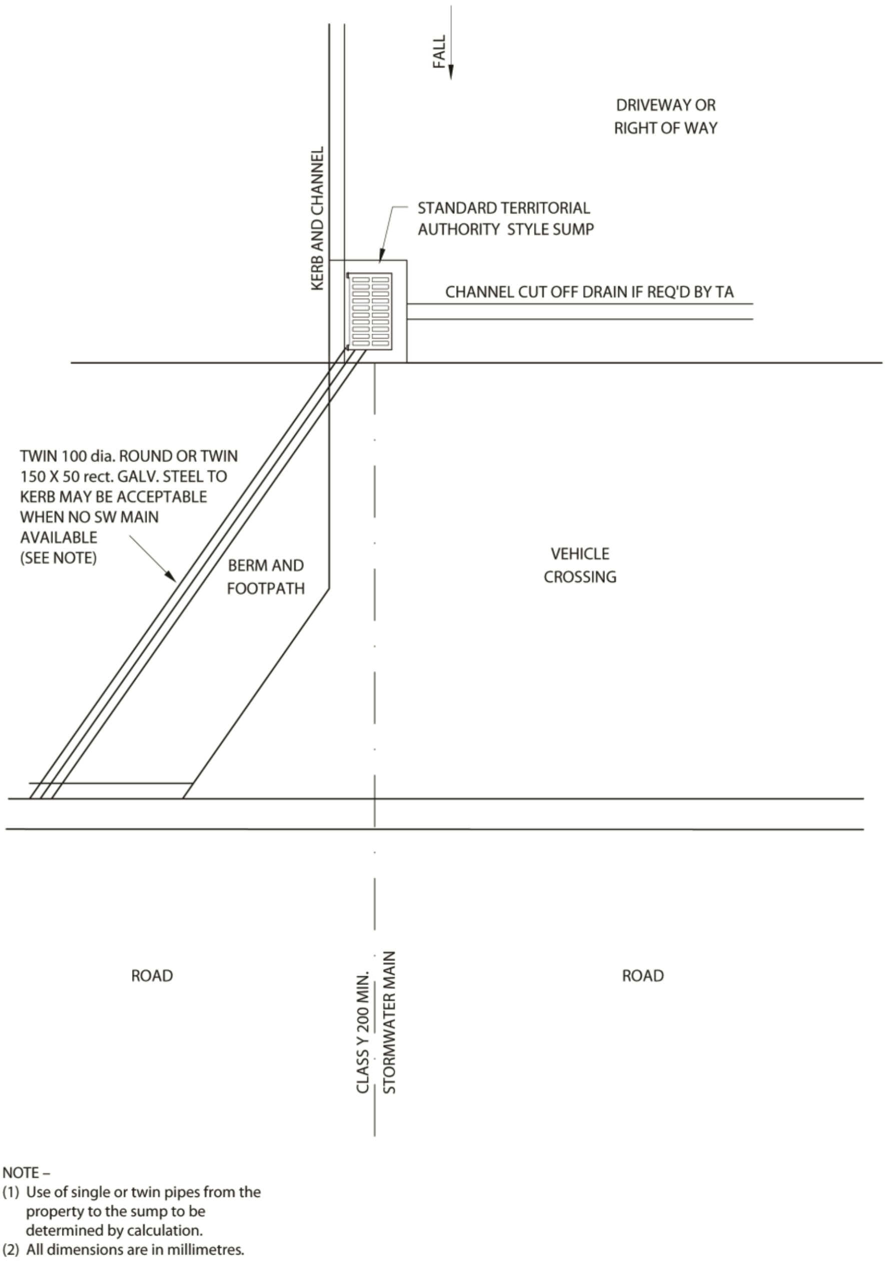


Figure 3.8 – Typical sump to driveway or right of way

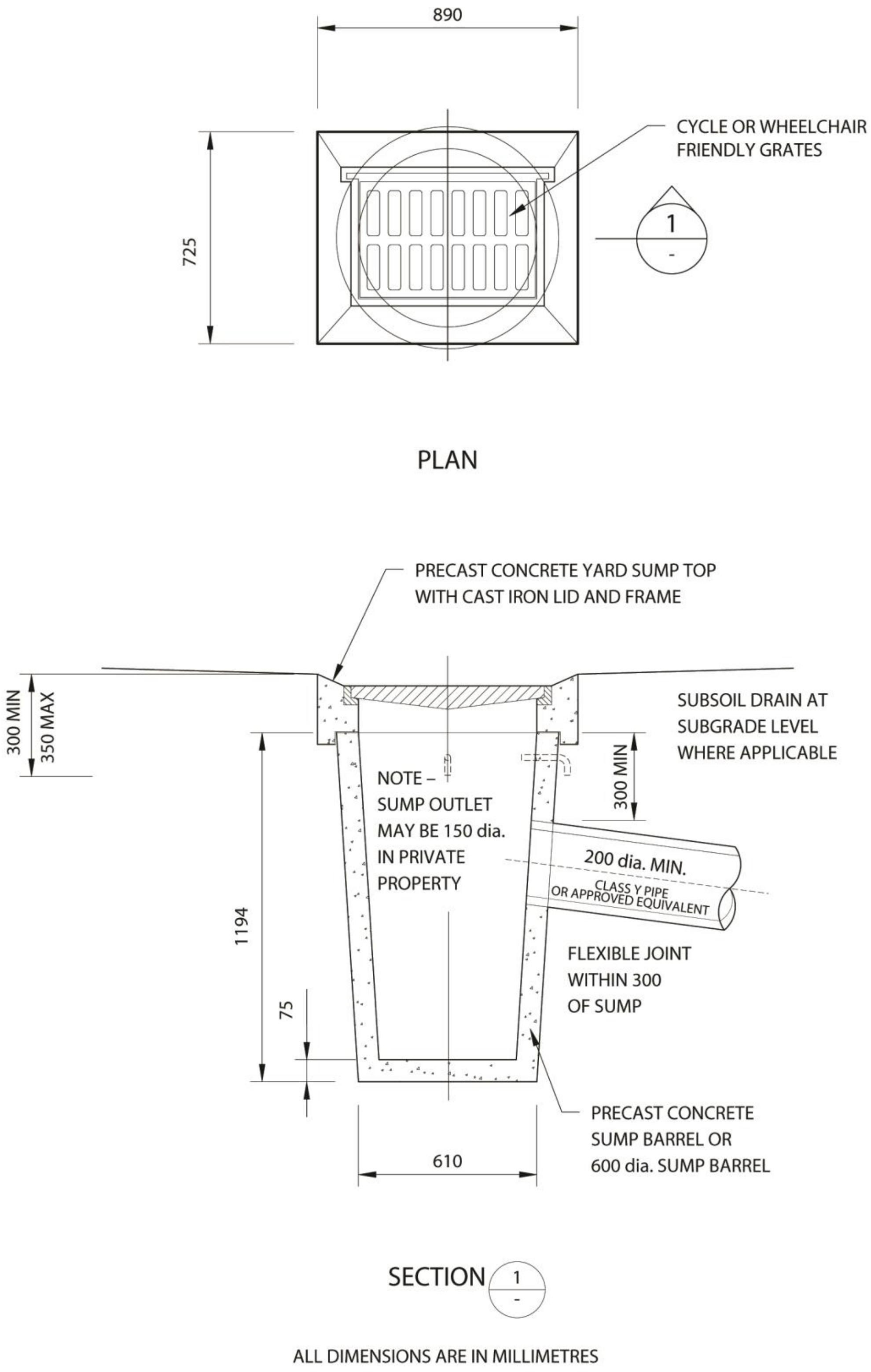


Figure 3.9 – Flat channel or yard sump *– Note Siphon required*

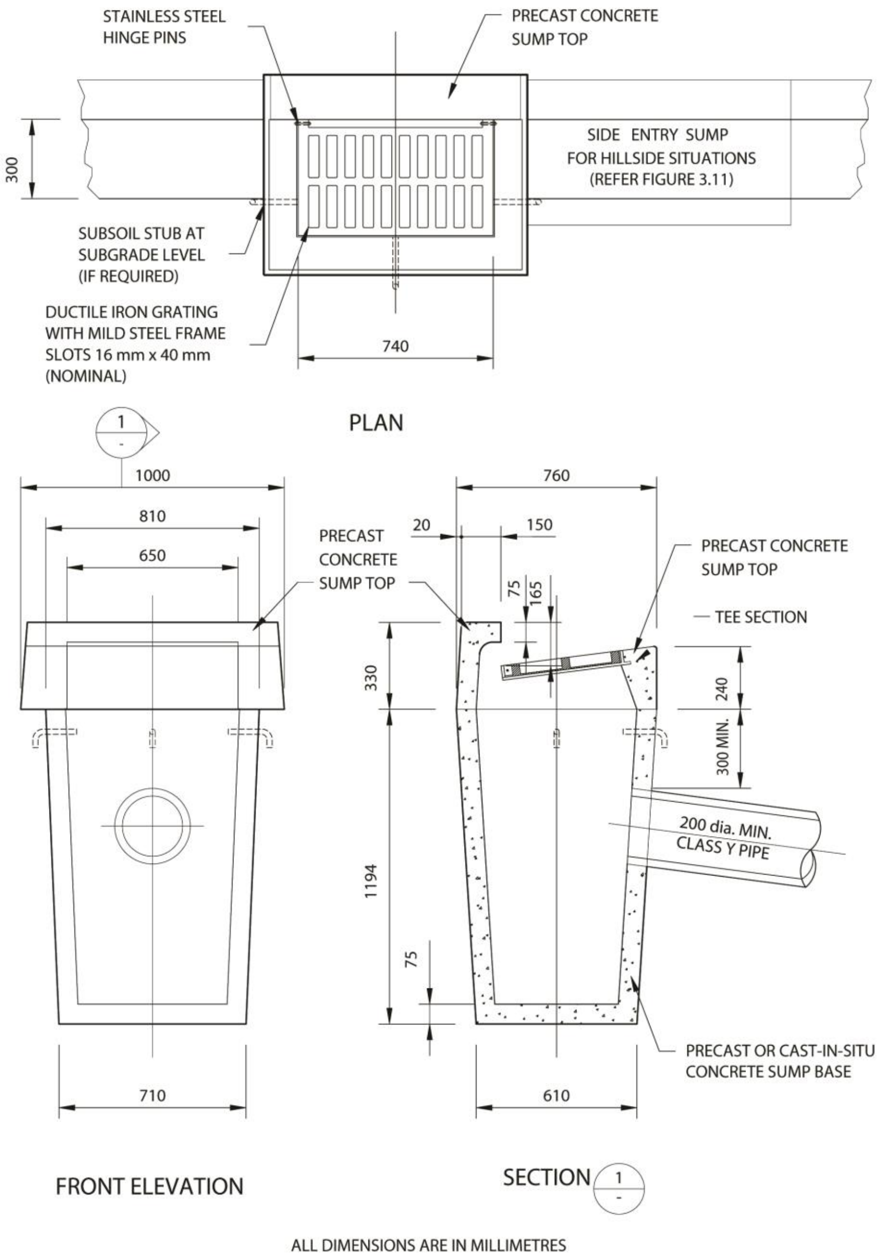


Figure 3.10 – Hillside sump – ***Note – Siphon Required***

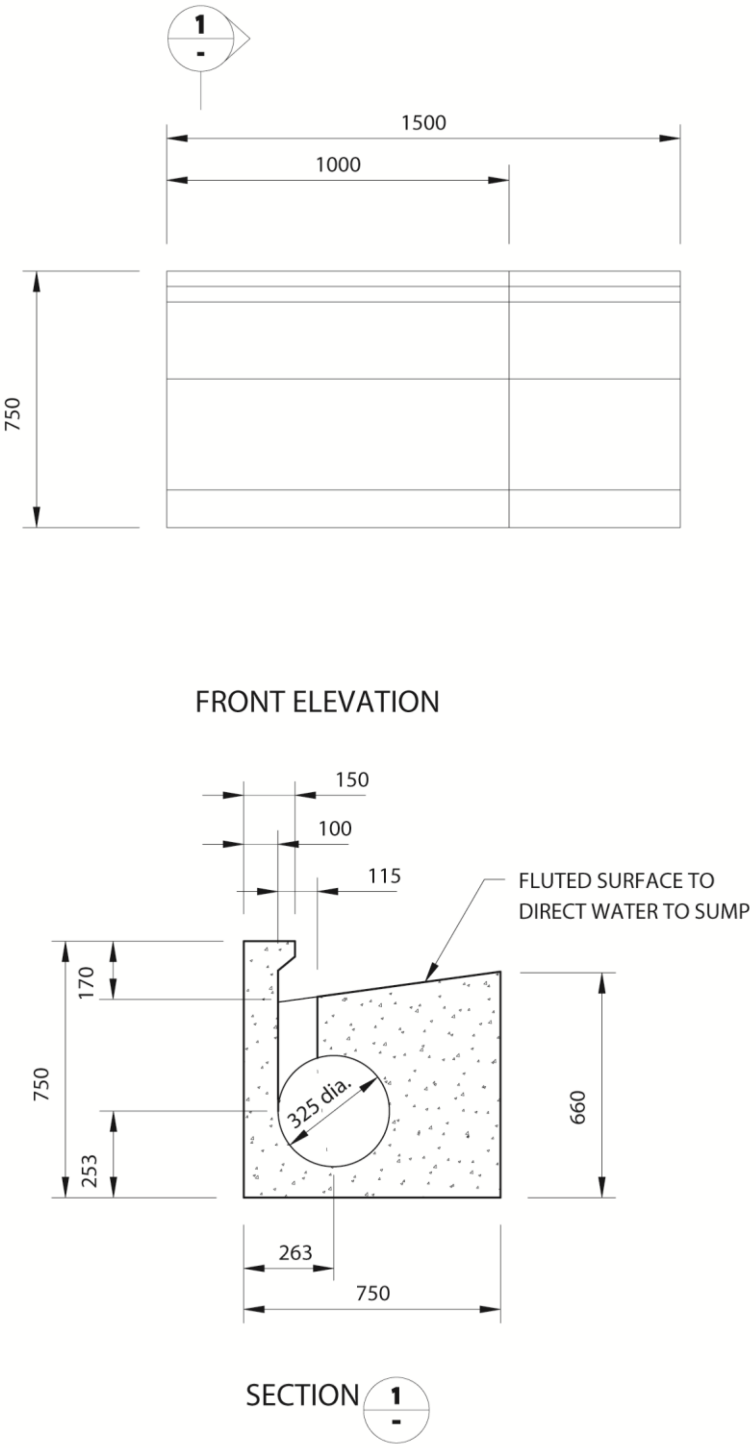


Figure 3.11 – Add-on to back-entry sump for hillside situations

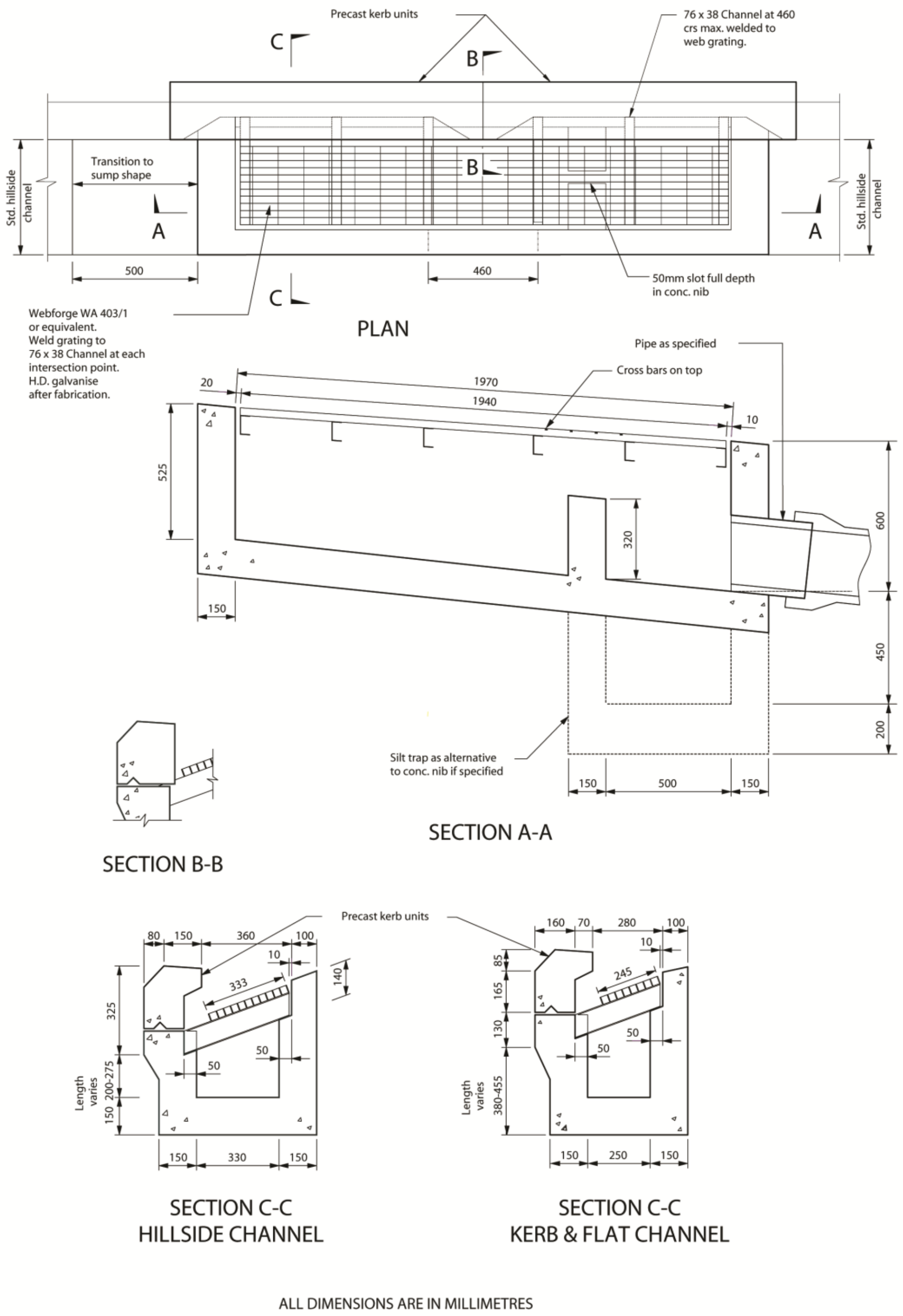


Figure 3.12 – An alternative sump for hillside situations – ***Note – Siphon Required***

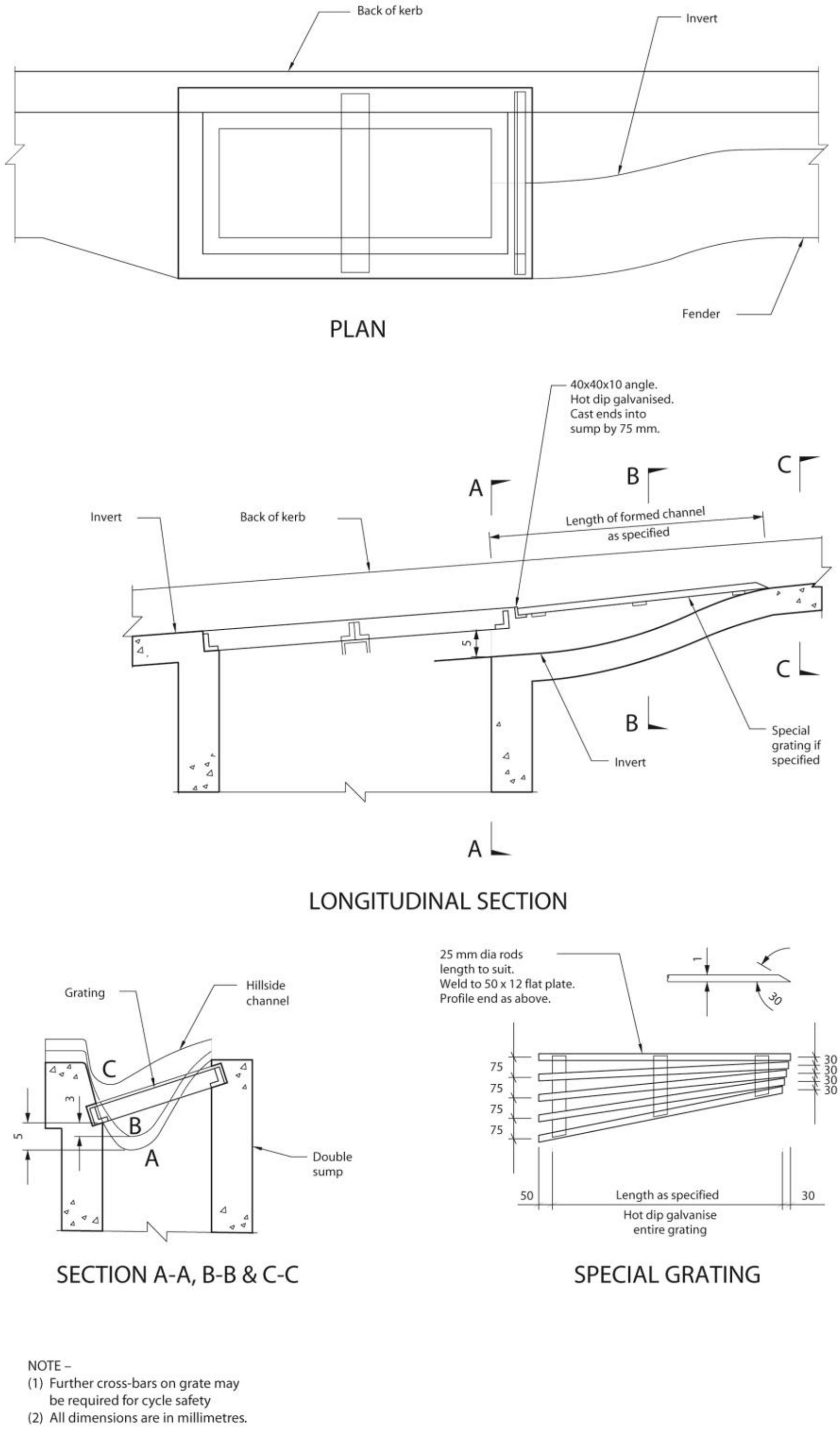


Figure 3.13 – Special entry to double sump in hillside channel *– Note – Siphon Required*

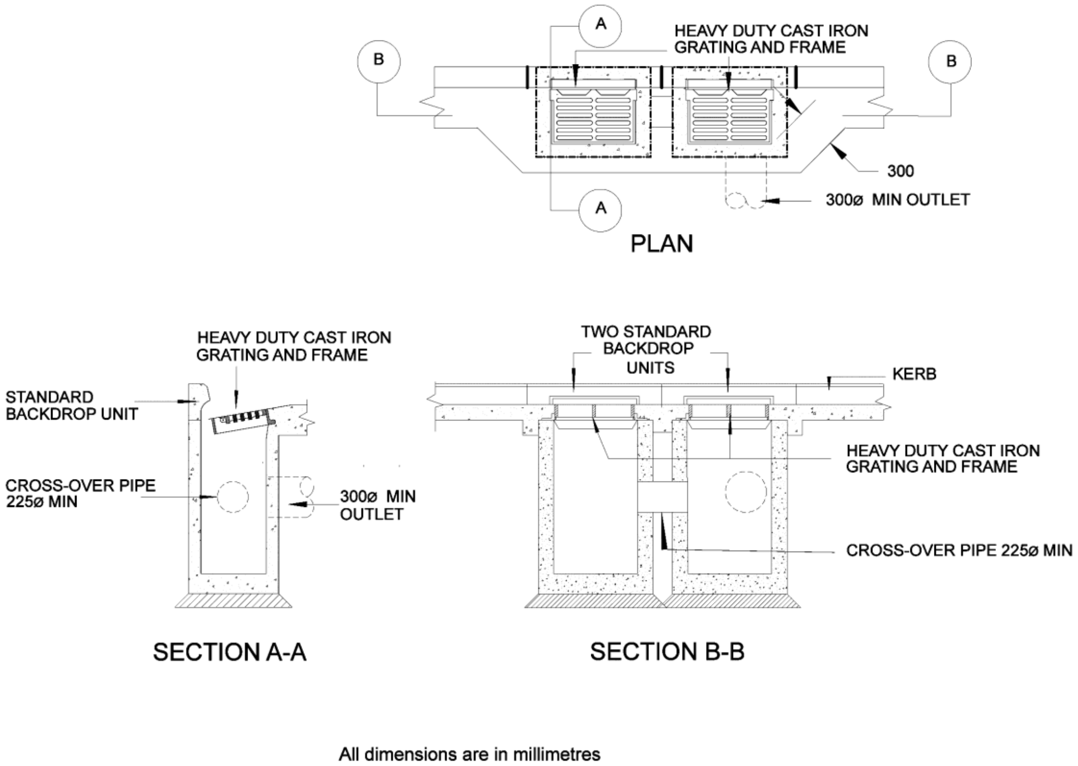


Figure 3.14 – Double back-entry sump for road low points – ***Note Siphons required***

3.3.19.7.2 Sump design

Sumps should be designed to intercept and convey stormwater run-off flow from design storm of the AEP set out by the TA, or otherwise stated in section 4 of this Code of Practice, while allowing a reasonable frequency and degree of traffic interference. Depending on the road classification, as specified by the TAs, portions of the road may be inundated during major storm events. See 4.3.4.2 for allowable floodwater depths.

The following general guidelines should be used in the design of sumps:

(a) General safety requirements

   (i) Provide for the safety of the public from being swept into the stormwater system; the maximum allowable opening shall not exceed 100 mm in width

   (ii) Openings are sufficiently small to prevent entry of debris that would clog the stormwater system

   (iii) Openings be sized and oriented to provide for safety of pedestrians and cyclists. Cycle-friendly sump grates shall be used where required by the TAs. These grates may be built either with bars transverse to the side channel direction or closely spaced bars in a wavy pattern in a longitudinal direction;

(b) Sump inlet capacities

   Inlet capacities of any sump used should be determined using manufacturers' and suppliers' data which should be based on either rational analysis or first principle calculations, otherwise sump inlet capacities should be calculated using approved design methods where applicable. When no proper data is available, the capacity of the single 675 x 450 back entry sump with standard grating should be limited to 28 L/s.The calculated sump inlet capacities should be reduced to account for partial blockage of the inlet with debris as follows:

On-grade grated back entry sump	10% reduction
On-grade grated sump	50% reduction
On-sag grated sump	50% reduction
On-sag grated back entry sump	Include back entry capacity only

(c) The use of silt traps is encouraged in all sumps to provide partial treatment to stormwater at the source, but in all cases, trapped sumps should be used where discharge to a soakage device is permitted.

3.3.19.7.3 Sump gratings

Sump grating areas shall be sized generously to allow for partial blockage to ensure that side-channel water does not bypass sumps when velocities are high.

Cycle-friendly sump grates shall be used where cyclists can be expected or when required by the TA. These gratings may be built either with bars transverse to the side-channel direction or closely spaced bars in a wavy pattern in a longitudinal direction.

3.3.19.7.4 Sump leads

Leads should be designed to be of sufficient size to convey all the design capacity of the sump to the system. The minimum size of the lead for all types of sumps shall be 200 mm diameter, but 300 mm diameter is desirable to minimise inlet losses and blockage risk. For double sumps and other high capacity sumps the minimum size of lead required is 300 mm diameter.

3.3.19.7.5 Secondary flow provisions

At all points where sump blockage may occur, or where design capacity may be exceeded, which could lead to overflow into private property, the provision of designed secondary flow paths protected by public ownership or easement shall be made (see 4.3.4.2).

3.4 Construction

3.4.1 Introduction

These requirements apply to flexible pavements. For rigid pavements, such as concrete pavements refer to Austroads guides, and the *Guide to residential streets and paths* as listed in Referenced Documents.

Road construction shall be carried out to the alignments and standards detailed in the approved drawings and with the specified materials so as to provide the intended design life.

The road construction includes all associated construction required to complete adjacent footpaths, berms, and road reserve areas.

All construction methods and materials shall be suitable for the climatic conditions experienced in the Queenstown Lakes District.

3.4.2 Materials for flexible pavements

3.4.2.1 Transition layer

A transition layer may be required for traffic loading in excess of 1×10^5 ESA where the subgrade is soft, to prevent ingress of the soft soils into the pavement layers. The transition layer may be filter metal complying with appropriate NZTA specifications or an approved geotextile filter fabric. The transition layer shall be compatible with the grading of adjacent layers and be regarded as part of the total depth of the sub-base layer.

3.4.2.2 Sub-base

The sub-base layer immediately beneath the basecourse shall have a permeability of at least 10^{-4} m/s for a depth of at least 100 mm.

The material used as sub-base shall be hard rock material with the largest aggregate size not larger than 60% of the depth of the layer or 65 mm. The material shall be sufficiently free draining so as not to be susceptible to undue weakening at highest in-service moisture content.

3.4.2.3 Basecourse

The thickness of the basecourse layer when used with other metal aggregate layers shall not be less than 100 mm.

Acceptable basecourse specifications are:

(a) NZTA approved regional basecourse
This is a slightly lower quality material than NZTA specified M/4. It may be used for roads of connector/collector class; or

(b) Local basecourse acceptable to the TA
This may be used for local roads in live and play areas and footpaths, kerb crossings, and shared accessways.

Material sourced from the Shotover River shall not be used in basecourse layers.

3.4.3 Road surfacing

3.4.3.1 Acceptable surfacing materials

All movement lanes shall be provided with a permanent, hard wearing surfacing layer, which shall be either impermeable or formed over an impermeable base. The surfacing shall be capable of carrying all stresses expected during its lifetime.

Acceptable surfacing options may include:

(a) Hot laid asphaltic concrete of minimum compacted thickness 30 mm, laid over a waterproofing sealcoat;

(b) Other asphaltic concrete mixes such as friction course or macadam wearing mix laid over a waterproofing coat;

(c) Chip seals of various types, providing the equivalent of two bound chip coatings;

(d) Concrete block pavers; and

(e) Stone block surfacing where designed for aesthetic effects.

To resist scuffing and local load effects, minimum surfacing standards as given in table 3.3 shall apply to the named facilities.

Use of concrete or stone block paving in public traffic areas shall require the specific approval of the TA.

Table 3.3 – Recommended surfacing standards

Facility	Minimum surfacing
Residential turning head	Segmental concrete pavers, concrete, 30 mm asphaltic concrete
Public carparks (excl. parallel parks)	Segmental concrete pavers, concrete, 30 mm asphaltic concrete
Commercial and industrial turning head	Segmental concrete pavers, concrete, 50 mm asphaltic concrete
Traffic islands and bus stops	Segmental concrete pavers, concrete, 50 mm asphaltic concrete

3.4.3.2 Road surface tolerances and texture

The finished surface of new roads shall have a NAASRA roughness satisfying the TA's standards at the time of construction. No abrupt or abnormal deviations shall occur and no areas shall pond water. The surface shall be of uniform texture expected by best trade practice and satisfy density standards applicable to the surfacing being used. The skid resistance and surface texture of roads where design speeds exceed 70 km/h, shall comply with NZTA specification T/10 and its accompanying notes.

Where hard surfacing is required for areas that are not movement lanes, alternative materials and porous pavements that achieve the durability, maintenance, and amenity requirements are acceptable with the approval of the TA.

> ***C3.4.3.2***
>
> *In the cases of narrow traffic islands and bus stops, where loading is concentrated, the use of stabilised base course is also desirable.*

3.4.4 Road surfacing materials

All materials used in road surfacing shall comply with the appropriate NZTA specifications.

The following surfacing options will be acceptable for roads covered by the Code of Practice.

3.4.4.1 First and second coat chip seals

For first coat seals the chip size shall generally be grade 3 on all roads.

For second coat seals the chip size shall generally be grade 4. Cycle and parking lanes shall be grade 6.

3.4.4.2 Double wet lock coat

First and second seals may be constructed in one operation with asphaltic cutback to NZTA M/1 and P/3 specifications.

The binder application rate for the seals shall be designed to suit the conditions and chip size.

Acceptable and compatible chip sizes are:

Local roads
First coat: grade 4, second coat: grade 6

Other roads
First coat: grade 3, second coat: grade 5 or 6.

3.4.4.3 Hot laid asphaltic concrete surfacing

Hot laid asphaltic concrete surfacing shall comply with NZTA specification M/10 or equivalent approved by the TA. The mix used shall be appropriate to the end use and thickness being placed.

A waterproofing seal coat, using asphaltic binder or emulsion, and grade 5 chip, with the requirement that the seal coat comprises a minimum of 1.0 L/m^2 of residual penetration grade bitumen, shall be laid prior to surfacing with asphaltic concrete of 50 mm or lesser thickness. No cut back shall be used in such coats as it can cause flushing of the asphalt overlay.

When using NZTA specification M/10 compliant mixes on roads of connector/collector class, NZTA guidelines on skid resistance and surface texture shall be incorporated in the mix design.

3.4.4.4 Other asphaltic mixes

For special uses other asphalt-based hot mixes may be used such as open grade porous asphalt or macadam wearing mix. When used they shall be placed over a waterproof under layer and shall be designed according to current specifications and guides. In no case shall the laid thickness be less than 25 mm.

3.4.4.5 Concrete

All concrete for roads shall come from a special grade plant as defined in NZS 3109. Concrete of not less than 30 MPa 28-day strength shall be used for any road or crossing slabs.

Concrete for kerbs and channel shall be of not less than 20 MPa, 28-day strength.

3.4.4.6 Concrete pavers

Design and material standards shall comply with NZS 3116. Paver thickness shall be as defined in NZS 3116 for the appropriate traffic loading classification.

When used in roads the basecourse underlayer shall be given a waterproofing seal coat before the sand and pavers are laid, except where part of a porous pavement is approved by the TA.

When used for bus stops or at raised crossings the basecourse shall be cement stabilised under the raised zone and for at least 3 m on either side of the raised zone.

Pavers shall be laid to 5 mm above the lips of channels and other draining features.

3.4.5 Subgrade checking

Where the extent of cut or fill for the project is too great to make subgrade CBR testing feasible at the design stage, it should be done on completion of earthworks when subgrade levels have been exposed. Even in cases where the subgrade has been tested as part of the design its condition shall be reviewed on exposure during construction and pavement thicknesses adjusted accordingly.

The results of such testing or review along with any consequent adjustments to pavement layer thicknesses shall be advised to the TA before placing of pavement layers commences.

Any identified wet spots in the subgrade shall be drained to the under-channel drainage system. Where the wet area is below the level of the under-channel drain, it shall be drained using approved filter drainpipes connected to the nearest stormwater system.

Between the date the subgrade is completed and the application of the first metal-course aggregate, the subgrade shall be maintained true to grade and cross section. Should potholes, soft spots or ravelling develop in the subgrade, the area so affected shall be scarified and clean material added and recompacted.

3.4.6 Spreading and compaction of metal course aggregates

The metal course aggregates shall be placed on the prepared subgrade in layers. The aggregate layers shall be of adequate thickness and stiffness to ensure that with adequate compaction the minimum required deflections are achieved.

3.4.7 Sub-base

Sub-base material shall be placed in layers thin enough to ensure requisite compaction and CBR standards are achieved. Sub-base shall be compacted in accordance with NZTA B/2 specification to achieve a mean of 95% of maximum dry density (MDD) and a minimum of 92% of MDD.

The layers shall be so placed that when compacted they will be true to the grades and levels required. The laying procedure shall be arranged to minimise segregation. Grader use shall be restricted to essential shaping and final trimming, with minimum working of the final surface.

The sub-base layer may be used by construction traffic, but such traffic shall be managed to ensure no detrimental effects to the final road construction.

3.4.8 Basecourse

Basecourse shall be placed in layers not exceeding 150 mm. It shall be placed and compacted to NZTA B/2 specification density requirements to achieve a mean of 98% MDD and a minimum of 95% MDD.

Where approved by the TA, cement stabilised basecourses should be placed and compacted in accordance with the NZTA B/5 specification.

To assist compaction, water may be added as a fine mist spray to achieve optimum moisture content. Particular care shall be taken to avoid excess water reaching the formation or sub-base course.

Fine aggregate may be hand spread in a comparatively dry state over any open textured portion of the final compacted aggregate surface. The fine aggregate shall be vibrated or rolled into the interstices of the basecourse. The use of such surface choking material shall be kept to a minimum. Special attention shall be paid to the consolidation of the edges of the basecourse.

The construction of the basecourse shall be carried out in a manner that will ensure the production of a stone mosaic surface after sweeping.

3.4.9 Maintenance of basecourse

The finished aggregate surface shall be maintained at all times true to grade and cross section by placement of a ‘running course’, watering as required, trimming, planning, rolling, and taking appropriate measures to ensure the even distribution of traffic.

Every precaution shall be taken to ensure that the surface of the basecourse does not pothole, ravel, rut or become uneven, but should any of these conditions become apparent, the surface shall be patched with suitable aggregate and completely scarified and recompacted. The basecourse shall be maintained to the specified standards until covered with an impermeable surfacing layer.

3.4.10 Basecourse preparation for surfacing

Any loose or caked material shall be removed from the surface without disturbing the compacted base, and the material so removed shall be disposed of. The surface shall then be swept clean of any dust, dirt, animal deposits, or other deleterious matter. The surface of the road at the time of surfacing shall be clean, dry and uniform, tightly compacted, and shall present a stone mosaic appearance. Immediately prior to any form of surfacing a strip 600 mm wide contiguous to each channel or seal edge shall be sprayed with an approved ground sterilising weed killer at the manufacturer’s recommended rate of application.

For second coat sealing, repairs shall be carried out prior to sealing. Areas to be patched shall be cleaned and loose material removed before application of an emulsion tack coat and asphaltic patching material. The repairs shall provide a finished surface flush with the levels and grades of the surrounding pavement, and shall not hold water.

Prior to commencement of sealing the surface preparation shall be inspected by the TA.

3.4.11 Deflection testing prior to surfacing

Where required by the TA prior to placing the surfacing layer (except for cast in situ concrete roads) deflections shall be tested by the Benkelman beam method (see table 3.4). At least 95% of all tests shall comply with the standards appropriate to the road type. Where the TA does not have its own deflection standards table 3.4 shall be considered as a minimum standard. In addition no test shall give deflections greater than 25% above the specified maximum.

Table 3.4 – Benkelman beam standards

Live and play	Deflections	Shop and trade	Deflections

	Average	Maximum	Work and learn Make and move	Average	Maximum
Lane	1.50 mm	1.80 mm	Lane	1.00 mm	1.20 mm
Local road	1.50 mm	1.80 mm	Local road	1.00 mm	1.20 mm
Connector/ collector	1.25 mm	1.50 mm	Connector/collector	1.00 mm	1.20 mm

Readings shall be taken in the wheel path in both lanes and at a maximum interval of 10 m.

3.4.12 Surfacing specification

Chipsealing construction standards shall comply with NZTA specifications P/3 and P/4.

Asphaltic concrete construction standards shall comply with NZTA specification P/9.

3.4.13 Bitumen application rate

Bitumen application rate for chipseals and tack coats shall be assessed based on current NZTA design methods and ambient weather conditions at the time of construction.

3.4.14 Footpaths and cycle paths

3.4.14.1 Concrete

Concrete footpaths and cycle paths shall be formed over not less than 100 mm of compacted metal. The formation is to be thoroughly compacted by rolling before any concrete is placed. Porous areas shall be blinded with sand prior to placing concrete.

The foundation shall be evenly trimmed to a crossfall of 1 in 50. If the foundation is dry, it shall be moistened in advance of placing concrete.

The concrete paths shall be laid with construction joints at intervals of not greater than 3 m. If paths are constructed by continuous pour techniques, clean, true, well-oiled 5 mm thick steel strips at least 40 mm deep shall be inserted at 3 m intervals to facilitate controlled cracking. These strips shall be carefully removed after the concrete has set. Alternatively, the joints may be cut by means of a concrete-cutting saw. In this case the cutting shall be carried out not more than 48 hours after pouring and shall be to a depth of 40 mm. These joints may also be typically tooled into the concrete when the concrete is still plastic.

Minimum concrete thickness for paths is 100 mm. Concrete in both footpaths and kerb and channel shall be cured for at least 7 days during dry weather.

Concrete used in footpaths shall be of at least 20 MPa, 28-day strength. Concrete for crossings shall be 30 MPa, 28-day strength as detailed in 3.4.4.5.

Where required, vehicle and pedestrian crossings shall be constructed in accordance with the TA standard details. Tactile pads may be required at pedestrian kerb crossings.

3.4.14.2 Asphaltic concrete

Asphaltic concrete footpaths and cycle paths shall be placed over not less than 100 mm of compacted basecourse after removal of all organic and soft subgrade. Asphaltic concrete shall be laid in a minimum layer thickness of 25 mm of mix M/10 material. Asphalt concrete paths shall not puddle water and shall be edged with either concrete or ground treated timber where abutting berms or other grassed areas.

3.4.14.3 Concrete pavers

Concrete pavers for footpaths shall be placed over not less than 100 mm of compacted basecourse after removal of all organic and soft subgrade. Laying shall be in accordance with NZS 3116. Pavers shall be laid to 5 mm above tops of channels and other drainage features.

3.4.14.4 Surface finish, tolerances

Surface finish and tolerances on footpaths shall comply with the appropriate design requirements.

3.4.15 Kerb and channel

Kerb and channel may be either cast in situ or extruded.

For cast in situ kerb and channel, formwork shall be clean dressed timber or steel sections adequately oiled or otherwise treated to allow ease of striking without staining or damaging of the stripped concrete surface.

No formwork shall be stripped until at least 2 days have elapsed from time of pouring concrete.

For extruded kerb and channel, concrete used shall be of such consistency that after extrusion it will maintain the kerb shape without support. The extrusion machine shall be operated to produce a well compacted mass of concrete free from surface pitting.

Concrete used in kerbs and channels shall be of at least 20 MPa, 28-day strength. Finished tolerances and standards shall satisfy the design standards.

3.4.16 Berms and landscaping

Berms shall be formed after all other construction has been completed. Grassed and planted areas shall have a 100 mm thick layer of topsoil free of weeds, stones, and other foreign matter and shall finish 15 mm above adjacent footpath level to allow for settlement.

After topsoiling, the berm shall be either sown or planted, or both, and maintained free of weeds for the contract maintenance period. The seed mix shall be approved by the TA.

When sown, rather than planted, grass coverage of not less than 90% shall be achieved within 1 month of sowing and before completion documentation will be accepted for processing by the TA.

For additional requirements for swales see 3.3.19.5.

Any landscaping in the road reserve shall be in accordance with section 7 of this Code of Practice.

3.4.17 Surface finish and tolerances on kerbs, paths, and accessways

3.4.17.1 Kerbs and channel

All curves both horizontal and vertical shall be tangential to straights and the lines and levels of kerbs shall be such as to give the finished kerbs smooth lines free of kinks and angles. Construction joints shall be placed in all unreinforced kerb and channel at 10 m centres.

Workmanship standards shall be such that, on straights, kerbing shall not deviate from a straight line by more than 6 mm in any length of 3 m. Similar standards shall apply to the gradient line. No visible ponding in new channels shall occur.

The exposed faces of the kerb and channel shall present smooth, uniform appearance free from honey-combing or other blemishes to at least U3 standard in NZS 3114.

3.4.17.2 Paths and accessways

Concrete paths and accessways shall be finished with a crossfall to shed water and an even non-skid brush surface to finish U5 in NZS 3114.

The surface of other paths/accessways shall be of uniform texture as would be expected from best trade standards for the surfacing used. Crossfalls of 2% shall be provided.

The surface of all paths/accessways shall not deviate by more than 6 mm from a 3 m straight edge at any point and no abrupt changes in line or level shall occur. No path/accessway shall pond water.

3.4.18 Progress inspections

The contractor shall give notice to the TA as appropriate to allow the conduct of all inspections required to facilitate eventual acceptance of the project by the TA.

3.4.19 Installation of traffic services, road furniture, benchmarks

Traffic lines and utility services shall be painted and marked after initial surfacing and sweeping has been completed. Road furniture and survey reference marks shall be installed, prior to final inspections being made by the TA.

3.4.20 As-built and completion documentation

On completion of construction, information and documents as required by the TA shall be provided by the developer’s professional advisor. (See Schedule 1D for further information.) The information provided shall provide sufficient detail to enable the TAs to complete the road assessment and maintenance management database input.

4 Stormwater

4.1 Scope

Where community specific guidelines are available these shall be taken into consideration throughout the design and construction of subdivisions and development.

This section sets out requirements for the design and construction of stormwater systems for land development and subdivision. The significant issues for stormwater management are the protection of people, property, infrastructure, and the receiving environment. Stormwater management requires the integration of land use, roading, and ecological factors. A catchment-based approach is required with consideration of changes in catchment hydrology, rainfall patterns, and sea level rise from climate change effects.

Opportunities exist with stormwater design to use or replicate the natural drainage system. Grassed swales, natural or artificial waterways, ponds and wetlands, for example, may in certain circumstances be not only part of the stormwater system, but also a preferred solution especially if low impact on receiving waters downstream is critical. Low impact design is the preferred approach, particularly where there is a requirement to replicate the pre-development hydrological regime. Nevertheless piped stormwater systems will often be required either in support of low impact systems or as the primary system.

Stormwater systems serve a number of purposes including the management of storm surface water run-off, treatment of such run-off, and groundwater control. All aspects need to be considered in design and achieved with minimal adverse effects on the environment.

4.2 General

4.2.1 Objectives

The designer shall agree the approach to be taken for stormwater with the Council prior to commencing any work.

The primary objective of a stormwater system is to manage storm surface water run-off to minimise flood damage and adverse effects on the environment.

The stormwater system shall include provision for:

(a) A level of service to the TA's customers in accordance with the authority's policies;

(b) Minimised adverse environmental and community impact;

(c) Protection from potential adverse effects to aquatic ecosystems;

(d) Compliance with environmental requirements;

(e) Adequate system capacity to service the fully developed catchment;

(f) Long service life with consideration of maintenance and life-cycle cost;

(g) Application of low impact design solutions.

4.2.2 Legislation and guidance manuals

Referenced legislation is listed in the Referenced Documents section of this Code of

Practice.

A selection of guidance manuals which may provide a useful resource or basis for stormwater design and management is set out in Referenced Documents and Related Documents. They are non-statutory in themselves but may be required to be complied with under regional or district plan rules.

4.2.3 Local authorities' requirements

The requirements of relevant regional and district plans on stormwater shall be met. Regional plan requirements will generally be limited to effects of stormwater on the natural environment. The TA exercises control over infrastructure associated with land development and subdivision.

Authorisation will be required from the regional council for the discharge of stormwater unless the discharge is to an existing and consented stormwater system and meets any conditions which apply to the existing system. Other activities often associated with stormwater infrastructure which need to be authorised by the regional council include: the diversion of natural water during construction, the permanent diversion of natural water as a consequence of the development, activities in the bed or on the banks of a natural waterway, and damming waterways.

The discharge of clean stormwater and other activities where effects are considered minor may be authorised as a permitted activity subject to certain conditions in the regional plan. Authorisation may also be by way of a comprehensive consent held by the TA for a large area or entire catchment.

In other circumstances site specific discharge permits and water permits shall be obtained. Advice should be sought from the LAs at the earliest stage of planning for stormwater infrastructure and receiving waters.

Discharge and temporary water permits required during construction shall be applied for by the developer and exercised in the name of the developer.

C4.2.3

The division of responsibilities between TAs and regional councils is set out in the Resource Management Act.

4.2.4 Catchment management planning

Stormwater management planning should be carried out on a subcatchment or catchment-wide basis. Where the proposed development is in an area covered by a local authority comprehensive catchment management plan, designers will be required to comply with the design philosophy in the plan.

If there is no catchment management plan for the area of the proposed development, the stormwater planning requirements should be discussed with the LAs at an early stage.

The implications of future development on adjoining land should be on the basis of replicating the pre-development hydrological regime whereby the maximum rate of discharge and peak flood levels post-development are no greater than pre-development.

Any catchment management planning issues should be discussed with LAs at an early stage.

The designer shall be responsible for checking that the capacity of the downstream network is adequate for any proposed increase in discharge with the Council.

4.2.5 Effects of land use on receiving waters

Impervious surfaces and piped stormwater systems associated with development have an effect on catchment hydrology. Faster run-off of storm flows, reduction in base flows, and accelerated channel erosion and depositions alter the hydrology and adversely affect the quality of receiving waters. Development should aim to minimise the increase in the frequency at which pre-development discharges are exceeded across a range of design rainfall events as this has implications for the biodiversity of the aquatic biological community.

The effects of rural development on receiving waters are generally less significant. The modification to stream hydrology is generally minor. However, any reduction in riparian vegetation increases sediment loads and nutrient concentrations are likely to reduce aquatic biodiversity.

4.2.6 System components

The stormwater system conveys storm surface run-off and shallow groundwater from the point of interception to soakage areas, attenuation areas, or the point of discharge to receiving waters. Components of the primary system may include roadside channels, swales and sumps, stormwater pipelines, subsoil drains, outlet structures, soakage areas, wetlands, ponds, and water quantity and quality control structures. Secondary surface flow paths to convey primary system overflows will also be required.

These different system components are set out on standard construction drawings contained in Appendix B. The drawings are copyright waived and may be adapted by subdivision developers for incorporation into specific designs.

4.2.7 Catchments and off-site effects

All stormwater systems shall provide for the management of stormwater run-off from within the land being developed together with any run-off from upstream catchments. In designing downstream facilities the upstream catchment shall be considered to be fully developed to the extent defined in the operative district plan or structure plan unless the TA advises that the upstream catchment will be required to be controlled for off-site effects at the time of its development.

For all land development infrastructure (including projects involving changes in land use or coverage) the design of the stormwater system shall include the evaluation of stormwater run-off changes on upstream and downstream properties. This evaluation will be required at the resource consent stage and may be linked to a requirement to replicate the pre-development hydrological regime.

Upstream flood levels shall not be increased by any downstream development unless any increase can be shown to have not more than a minor impact on the upstream properties.

Downstream impacts could include (but are not limited to) changes in flow peaks and patterns, flood water levels, contamination levels and erosion or silting effects, and effects on the existing stormwater system. Where such impacts are more than minor, mitigation measures such as peak flow attenuation, velocity control, and treatment devices will be required.

Fish passage shall be maintained. This is likely to be a requirement of any authorisation from the regional council.

4.2.8 Water quality

Stormwater treatment devices may be required to avoid adverse water quality effects on receiving waters. The type of potential contaminants should be identified and then treatment devices designed to address the particular issues. The need for treatment devices should be considered for every discharge even when it is not a direct discharge to a receiving water, for instance where the discharge is to an existing network. In this instance specific approval from the TA will be required.

4.2.9 Climate change

Climate change is expected to increase the intensity and frequency of heavy rainfall events, even in areas where mean annual rainfall is predicted to decrease. In low-lying coastal areas higher sea levels will also affect rivers, streams, and stormwater outfalls. The performance of stormwater systems in these areas will need to take into account higher predicted downstream sea levels.

Rainfall design charts shall be adjusted to take into account the predicted increase in rainfall intensities from the effects of climate change.

C4.2.9

Refer to the following Ministry for the Environment publications for guidance on climate change:

'Preparing for climate change – A guide for local government in New Zealand' for guidance on adjusting rainfall design charts at selected locations within each regional council area.

'Preparing for coastal change – A guide for local government in New Zealand' for guidance on coastal hazards and climate change.

'Tools for estimating the effects of climate change on flood flow – A guidance manual for local government in New Zealand' for incorporating climate change in flood flow estimation.

'Preparing for future flooding – A guide for local government in New Zealand' provides an overview of the expected impacts of climate change on flooding.

4.3 Design

4.3.1 Design life

All stormwater systems shall be designed and constructed for an asset life of at least 100 years. Some low impact design devices such as rain gardens and other soakage systems may require earlier renovation or replacement.

4.3.2 Structure plan

The TA may provide a structure plan setting out certain information to be used in design, such as flows, sizing, upstream controls, pipe layout, treatment, or mitigation requirements. Catchment management plans should detail the appropriate stormwater management options for the given structure plan area. Where a structure plan is not provided, the designer shall determine the information by investigation using any catchment management plan for the area, this Code of Practice, and any requirements of the TA, as appropriate.

4.3.3 Future development

Unless agreed in writing by the Council where further subdivision or development is allowed for within the current district plan upstream of the one under consideration the council shall require infrastructure to be constructed to the upper limits of the subdivision/development to allow for future connections.

The assessment of required capacity shall be on the basis of full development to the extent defined in the current district plan. Where infrastructure may service adjacent land then the full development to the extent defined in the current district plan of all the land that may be serviced by the infrastructure shall be included in the capacity calculations.

Where the new infrastructure being installed is required by Council to service future development then that infrastructure will be designed and constructed on the basis of full development to the extent defined in the current district plan.

The cost of increased infrastructure to service adjacent future development shall be agreed in writing with the Council's Asset Performance Team prior to commencing work.

4.3.4 System design

4.3.4.1 Primary and secondary systems

Stormwater systems shall be considered as the total system protecting people, land, infrastructure, and the receiving environment.

A stormwater system consists of:

(a) A primary system designed to accommodate a specified design rainfall event; and

(b) A secondary system to ensure that the effects of stormwater run-off from events that exceed the capacity of the primary system are managed, including occasions when there are blockages in the primary system.

4.3.4.2 Secondary systems

Secondary systems shall consist of ponding areas and overland flow paths to manage excess run-off. Where possible, secondary systems shall be located on land that is, or is proposed to become public land. If located on private land, the secondary system shall be protected by legal easements in favour of the TA or by other encumbrances prohibiting earthworks, fences, or other structures, as appropriate.

Secondary systems shall be designed so that erosion or land instability will not occur. Where necessary the design shall incorporate special measures to protect the land against such events.

Ponding or secondary flow on local roads shall be limited to a 100 mm maximum height at the centre line and velocity such that the carriageway is passable in a 5% AEP design storm.

The TA should be consulted to confirm design requirements.

> ***C4.3.4.2***
>
> *The Austroads 'Guide to road design – Part 5: Drainage design' provides more information on major and minor stormwater design and acceptable volume and velocity for surface flow.*

4.3.5 Design criteria

When the design process includes the use of a hydrological or hydraulic model, all underlying assumptions (such as run-off coefficients, time of concentration, and catchment areas) shall be clearly stated so that a manual check of calculations is possible. A copy of the model may be required by the TA for either review or records or both.

The design shall accommodate all upstream catchments on the basis of full development allowed for in the district plan. (The catchment area shall be based on geographical and topographical boundaries and not development boundaries).

Discharge to an existing reticulated network, or other Council owned stormwater network, shall require consent/permission from the Council.

Discharge to an existing network from a primary system shall be at a rate (litres per second) no greater than would have occurred for the undeveloped catchment during a 60 minute 5 year storm.

The designer shall undertake the necessary design and prepare design drawings compatible with the TA's design and performance parameters. Designers shall ensure the following aspects have been considered and where appropriate included in the design:

(a) The size of pipes, ponds, swales, wetlands, and other devices in the proposed stormwater management system;

(b) How the roading stormwater design is integrated into the overall stormwater system;

(c) The type and class of materials proposed to be used;

(d) System layouts and alignments including:

    (i) Route selection

    (ii) Topographical and environmental aspects (see 5.3.4.3)

    (iii) Easements

    (iv) Clearances from underground services and structures (see 5.3.7.9 and 5.3.7.10)

    (v) Provision for future extensions;

    (vi) Location of secondary flowpaths;

(e) Hydraulic adequacy (see 4.3.9.5); and

(f) Property service connection locations and sizes (see 4.3.11).

The designer should liaise with the TA, prior to commencement of design, to ensure that sufficient prerequisite information is available to undertake the design.

For catchments less than 50 ha, surface water run-off using the Rational Method will generally be accepted. For larger catchments, or where significant storage elements (such as ponds) are incorporated, surface water run-off should be determined using an appropriate hydrological or hydraulic model.

The New Zealand Building Code (NZBC) clause E1/VM1 provides guidance in the design of pipes, culverts, and open channel hydraulics.

4.3.5.1 Design storms

All new stormwater systems shall be designed to cope with climate change adjusted design storms of at least the annual exceedence probability (AEP) set out in table 4.1 unless specific approval has been obtained from the TA.

Table 4.1 – Recommended AEP for design storms

All Primary Systems shall, as a minimum, cater for the worst case 1 in 20 year return period (5% AEP) storm with no surface flooding. Where no secondary flow path is available the worst case 1 in 100 year return period (1% AEP) storm shall be catered for with no surface flooding.

C4.3.5.1

Rainfall intensity design charts developed from local data should be used if available. High Intensity Rainfall Design Systems (HIRDS) data available from NIWA is another source for rainfall design data.

4.3.5.2 Freeboard

The minimum freeboard height additional to the computed top water flood level of the 1% AEP design storm should be as follows or as specified in the district or regional plan:

Freeboard	**Minimum height**
Habitable dwellings (including attached garages)	0.5 m
Commercial and industrial buildings	0.3 m
Non-habitable residential buildings and detached garages	0.2 m

The minimum freeboard shall be measured from the top water level to the building platform level or the underside of the floor joists or underside of the floor slab, whichever is applicable.

4.3.5.3 Tidal areas

In tidal areas, design criteria should be discussed with the LAs at an early stage. Storm surge, tsunami hazards, climate change, and sea level rise need to be taken into account in accordance with the proposed NES on sea level rise and assessed in line with the Ministry for the Environment guidance manual *Coastal hazards and climate change – A guidance manual for local government in New Zealand.*

4.3.5.4 Hydraulic design of stormwater systems

The hydraulic design of stormwater pipes should be based on either the Colebrook-White formula or the Manning formula. System capacity shall be determined from the Colebrook-White or Manning coefficient as shown in table 4.2. The Colebrook-White and Manning formulae can be found in *Metrication: Hydraulic data and formulae* (Lamont). Manufacturers' specifications should also be referred to.

C4.3.5.4

Refer to 'Roughness characteristics of New Zealand rivers' by D M Hicks and P D Mason for further guidance on the selection of Manning's 'n' values. This handbook emphasises that the Manning's 'n' values can vary significantly with flow and the selected value should be based on the graphs of Manning's 'n' versus discharge presented for each site.

Table 4.2 – Guide to roughness coefficients for gravity stormwater pipes concentrically jointed and clean

Description	**Colebrook-White coefficient k** (mm)	**Manning roughness coefficient** (n)
Circular pipes		
PVC	0.003 – 0.015	0.008 – 0.009
PE	0.003 – 0.015	0.008 – 0.009
Vitreous clay	0.15 – 0.6	0.010 – 0.013
Concrete – machine made to AS/NZS 4058	0.03 – 0.15	0.009 – 0.012
Corrugated metal	–	0.012 – 0.024
GRP (glass reinforced plastic)	0.003 – 0.015	0.008 – 0.009
Culverts		
Concrete pre-cast (pipes and boxes)	0.6	0.016
Open channel		
Straight uniform channel in earth and gravel in good condition	–	0.0225
Unlined channel in earth and gravel with some bends and in fair condition	–	0.025
Channel with rough stony bed or with weeds on earth bank and natural	–	0.030
Winding natural streams with generally clean bed but with some pools and	–	0.035
Winding natural streams with irregular cross section and some obstruction	–	0.045
Irregular natural stream with obstruction from vegetation and debris	–	0.060
Very weedy irregular winding stream obstructed with significant overgrown	–	0.100
NOTE – Refer to AS 2200 table 2 and notes, and *Metrication: Hydraulic data and formulae* (Lamont).		

4.3.5.5 Energy loss through structures

Energy loss is expressed as velocity head:

Energy loss $H_e = kV^2/2g$

where k is the entrance loss coefficient and V is velocity.

The entrance loss coefficient table and energy loss coefficient graph in NZBC clause

E1/VM1 provide k values for flow through inlets and access chambers respectively.

For bends, see table A1 in Appendix A.

4.3.5.6 Determination of water surface profiles

Stormwater systems shall be designed by calculating or computer modelling backwater profiles from an appropriate outfall water level. On steep gradients both inlet control and hydraulic grade line analysis shall be used and the more severe relevant condition adopted for design purposes. For pipe networks at MHs and other nodes, water levels computed at design flow shall not exceed finished ground level while allowing existing and future connections to function satisfactorily.

In principle, each step in the determination of a water surface profile involves calculating a water level upstream (h_2) for a given value of discharge and a given start water level downstream (h_1).

This can be represented as:

$$h_2 + V_2^2 / 2\,g = h_1 + V_1^2 / 2\,g + H_f + H_e$$

where V is velocity,

H_f is head loss due to boundary resistance within the reach (for pipes, unit head loss is read from Manning's flow charts, for example),

H_e is head loss within the reach due to changes in cross section and alignment (see table 4.3 for loss coefficients).

Table 4.3 – Loss coefficients for bends

Bends	**k**
MH properly benched with radius of bend	
1.5 x pipe diameter	0.5 to 1.0
Bend angle	
90^o	0.90
45^o	0.60
22.5^o	0.25

4.3.6 Stormwater pumping

Stormwater pumping should be avoided wherever possible. However, in certain circumstances for low lying areas, and where gravity drainage is difficult to achieve, stormwater pumping may be required to achieve the appropriate levels of service and protection.

The consequences and risk of pump malfunction and power outages should be considered carefully.

C4.3.6

Sea level rise scenarios may need to be assessed in line with the proposed NES on sea level rise. Such assessments are likely to indicate the need to design for or at least plan for stormwater pumping in the future to ensure levels of service are maintained throughout asset life.

4.3.7 Low impact design

Low impact design aims to use natural processes such as vegetation and soil media to provide stormwater management solutions as well as adding value to urban environments. The main principles of low impact design are reducing stormwater generation by reducing impervious areas, minimising site disturbance, and avoiding discharge of contaminants. Stormwater should be managed as close to the point of origin as possible to minimise collection and conveyance. Benefits include limiting discharges of silt, suspended solids, and other pollutants into receiving waters, and protecting and enhancing natural waterways.

Effective implementation of LID principles typically requires more planning and design input than piped stormwater systems. Aspects in the design process requiring specific consideration include provision of secondary flow paths, land requirements, and provision for effective operation and maintenance.

> ***C4.3.7***
>
> *Useful guidance on low impact design practices can be found in the following Auckland Regional Council (ARC) publications: 'Low impact design manual for the Auckland region, Technical Publication 124'; 'Application of low impact design to brownfield sites, Technical Report 2008-20'; and 'Integration of low impact design, urban design and urban form principles, Technical Report 2009-83'.*
>
> *Additional guides that may be useful are listed in Referenced Documents and Related Documents.*

4.3.7.1 Low impact design stormwater system

The Council's preferred method of stormwater control is a low impact design solution. The designer shall gain written approval from the Council's Asset Performance Team that the proposed maintenance requirements are acceptable prior to submitting a design for acceptance.

Low impact design is a type of stormwater system that aims to minimise environmental impacts by:

(a) Reducing peak flow discharges by flow attenuation;

(b) Eliminating or reducing discharges by infiltration or soakage;

(c) Improving water quality by filtration;

(d) Installing detention devices for beneficial reuse.

4.3.7.2 Low impact design process

Key design considerations include:

(a) Design objective. The need to be clear about what is being designed for is important to informing decisions on the type of device and maintenance approach that is appropriate in a given context. Low impact devices offer many opportunities to deliver multiple outcomes in addition to their stormwater functionality;

(b) Device selection. The proper design and position of a product or device within the stormwater treatment train is important. It is critical to select a device or product that is fit for purpose, robust, and effective for delivering the design objective over its design life. Problems with the operation and maintenance of a device can occur when it is inappropriate for a given location or is undersized for its purpose. The respective position of the various components in the treatment train is an important consideration in ensuring the sustained effectiveness of the system;

(c) Integrated approach. Ensure that those who will become responsible for the ongoing operation and maintenance of low impact devices are involved in the design process. This is critical to informing the development of a practical design that will enable ease of maintenance and develop ownership for ensuring the device performs as it was intended;

(d) Design for maintenance. Maintenance of devices shall be considered early in the design process. This will assist in the identification of features that will facilitate the ease and efficiency of ongoing operation and maintenance of devices. Elements to consider in the design for the maintenance and operation of the systems include:

(i) Access

(ii) Vegetation

(iii) Mulch

(iv) Sediment

(v) Mechanical components

(vi) Vandalism and safety.

4.3.7.3 Low impact design devices

The types of low impact design devices that could be considered for use include:

(a) Detention ponds;

(b) Wetlands;

(c) Vegetated swales;

(d) Rain gardens;

(e) Rainwater tanks;

(f) Soakage pits and soak holes;

(g) Filter strips;

(h) Infiltration trenches/basins;

(i) Permeable paving;

(j) Green roofs;

(k) Tree pits.

4.3.7.4 Detention ponds

Detention ponds shall only be used with prior approval from the Council.

Stormwater ponds are an accepted method of improving stormwater quality and reducing peak downstream flow rates to replicate the pre-development hydrological regime.

Detention ponds can be of the 'dry' or 'wet' type and can be 'on-line' or 'off-line'. The type of pond required should be discussed with the LA at an early stage.

Specific matters to be considered in pond design include:

(a) Side slope stability;

(b) Shallow ledges or batters for safety;

(c) Ease of access and maintenance including mowing and silt clean out;

(d) Shape and contour for amenity and habitat value;

(e) Effectiveness of inlet and outlet structures;

(f) Overflow design and scour protection;

(g) Fish passage;

(h) Pest control (for example mosquitoes and blue-green algae);

(i) Species to be planted;

(j) Potential effect on downstream aquatic ecology and habitat;

(k) Maintenance requirements.

If the TA is to be responsible for pond maintenance it shall be located on land owned by, or to be vested in, the TA or protected by an appropriate easement.

4.3.7.5 Wetlands

Constructed wetlands can be designed to provide flood protection, flow attenuation, water quality improvement, recreational and landscape amenity, and provision for wildlife habitat.

Specific matters to be considered in wetland design include:

(a) Catchment area greater than 1 ha;

(b) Size calculated to achieve water quality volume;

(c) Forebay to capture coarse sediments;

(d) Depth not to exceed 1 m;

(e) Sufficient hydraulic capacity for flood flows;

(f) Sufficient detention time for sediment retention;

(g) Species to be planted.

If the TA is to be responsible for wetlands maintenance it shall be located on land owned by, or to be vested in, the TA or protected by an appropriate easement.

4.3.7.6 Vegetated swales

Vegetated swales are stormwater channels that are often located alongside roads or in reserves. While their primary function is conveyance, filtration through the vegetation provides some water quality treatment.

Specific matters to be considered in swale design include:

(a) Catchment area not greater than 4 ha;

(b) Longitudinal slope 1% – 5%;

(c) Slopes flatter than 1% may require underdrains;

(d) Slopes greater than 5% may require check dams to reduce effective gradient to less than 5%;

(e) Capacity for a 10% AEP event;

(f) Velocity not greater than 1.5 m/s in a 10% AEP event unless erosion protection is provided;

(g) Grass length 50 mm – 100 mm;

(h) Species to be planted.

An option for swales with very flat longitudinal slopes and high water tables is a wetland swale.

Typical details that may be used in swale design are shown in figures 3.6(A), 3.6(B), and 3.6(C).

4.3.7.7 Rain gardens

Rain gardens are engineered bioretention systems designed to use the natural ability of flora and soils to reduce stormwater volumes, peak flows, and contamination loads. Rain gardens also provide value through attractive design and planting. Specific matters to be considered in rain garden design include:

(a) System designed to manage a 10% AEP event without significant scour or erosion;

(b) Overland flow paths to accommodate flows in excess of the design storm;

(c) Entry and overflow positions to restrict short circuiting;

(d) Geotextile on side walls;

(e) An underdrain with a minimum of 50 mm gravel cover;

(f) Pavement design in vicinity of device;

(g) Soil composition;

(h) A ponding area;

(i) Species to be planted;

(j) Access for maintenance.

4.3.7.8 Rainwater tanks

Rainwater tanks can be designed to harvest water for non-potable uses such as toilet flushing and watering the garden. This can significantly reduce the demand on the potable water supply from the TA. Where required by the TA rainwater tanks can be configured to provide peak flow attenuation, to reduce stream channel erosion and the load on the stormwater system, with or without reuse.

Specific matters to be considered in rainwater tank design include:

(a) Capacity: Typically 2,000 L – 5,000 L for domestic reuse and 6,000 L – 9,000 L for dual reuse and attenuation;

(b) Primary screening to keep out leaves and other coarse debris;

(c) First-flush diverters to collect first 0.4 mm for slow release to ground through a small chamber;

(d) Backflow prevention;

(e) Low level mains top-up valve;

(f) Overflow outlet;

(g) Gravity or pumped;

(h) Tight-fitting cover;

(i) Cool location;

(j) Aesthetics and convenience.

4.3.7.9 Soakage devices

Soakage devices such as soak pits and soak holes, filter strips, infiltration trenches/basins, permeable paving, green roofs, and tree pits can also be considered for managing stormwater from roofs, parking areas, and roads.

Specific matters to be considered in soakage system design include:

(a) Capacity adequate for a 5% AEP event;

(b) Rate of soakage determined through a soakage test with an appropriate reduction factor (at least 0.5) applied to accommodate loss of performance over time;

(c) Capacity to accommodate the maximum potential impermeable area;

(d) Overland flow paths to accommodate flows in excess of the design storm;

(e) Confirmation that the soakage system will not have an adverse effect on surrounding land and properties from land stability, seepage, or overland flow issues;

(f) Soakage system to be located above static groundwater level;

(g) Pre-treatment device to minimise silt ingress may be required;

(h) Interception of hydrocarbons;

(i) Access for maintenance.

For guidance on disposal using soakage on individual lots refer to NZBC clause E1/VM1.

The TA may require a geotechnical assessment to be carried out by an appropriately qualified geo-professional to determine the suitability of soil and groundwater characteristics for any proposed soakage system.

A discharge permit may be required from the regional council for discharge to soakage.

> ***C4.3.7.9***
>
> *National and international references that may be able to be used in the design and maintenance of such systems are listed in Referenced Documents and Related Documents.*

4.3.8 Natural and constructed waterways

Where waterways are to be incorporated in the stormwater system, they shall be located within a reserve of sufficient width to contain the full design storm flow with a minimum freeboard of 500 mm.

Grass berms in reserves shall have a maximum side slope of 1 in 5 and additionally include a vehicular access berm for maintenance purposes.

Reserves should be designed to accommodate off-road pedestrian and cycle access for recreational use. Planted riparian margins should be provided each side of the waterway (see 7.2.4).

All channel infrastructure shall include protection against scour and erosion of the stream banks and stream bed.

If the watercourse is to be in private property and be maintained by the TA it shall be protected by an easement.

4.3.9 Pipelines and culverts

4.3.9.1 Location and alignment of public mains

The preferred location of public mains shall be within the road reserve or within other public land.

Where required by the TA easements shall be provided for stormwater pipelines located on private property.

A straight alignment between manholes (MHs) is required unless there are special circumstances. See 5.3.7.6 and 5.3.7.7 for further guidance on curved alignments for stormwater pipelines.

4.3.9.2 Materials

All pipes shall be PE 100, PVC (minimum class SN8) or rubber ring joint reinforced concrete and meet the relevant standards as listed in Table A1 of NZS4404:2010. Unless otherwise agreed in writing by the Council. Acceptance of design documentation without separate written approval shall not constitute acceptance of an alternative material.

For materials for which there is no New Zealand or Australian Standard the specific approval of the TA is required.

4.3.9.3 Minimum pipe sizes

Minimum pipe sizes for public mains and sump leads unless otherwise specified shall be:

Single sump outlets	–	200 mm internal diameter
Public mains	–	200 mm internal diameter where only taking house leads
	–	300 mm internal diameter for all other mains and double sump leads.

4.3.9.4 Minimum cover

Where the TA does not have specific requirements, the minimum covers as described in AS/NZS 2566.2 (for buried flexible pipelines) or AS/NZS 3725 (for buried concrete pipes) may be used.

Cover in carriageways, footpaths and crossings shall be no less than 1m. Cover outside of the carriageway, footpaths, crossings or other trafficable areas shall be no less than 0.6m.

4.3.9.5 Minimum gradients and flow velocities

In flat areas gradients should be as steep as possible to control silt deposition. The minimum velocity should be at least 0.6 m/s at a flow of half the 50% AEP design flow. For velocities greater than 3.0 m/s see 5.3.5.6.

4.3.9.6 Culverts

In designing culverts the effects of inlet and tailwater controls shall be considered.

Culverts under fills shall be of suitable capacity to cope with the design storm with no surcharge at the inlet, unless the fill is part of a stormwater detention device or has been designed to act in surcharge. All culverts shall be provided with adequate wingwalls, headwalls, aprons, scour protection, removable debris traps or pits to prevent scouring or blocking. Special consideration shall be given to the effects of surcharging or blocking of culverts under fill.

Fish passage through culverts shall always be maintained.

Refer to the NZTA *Bridge manual* for waterway design at bridges and culverts.

4.3.9.7 Inlets and outlets

Where a pipeline discharges into a natural or constructed waterway, or vice versa, consideration shall be given to energy dissipation or losses, erosion control, and land instability. This is often achieved by an appropriately designed headwall structure.

For outlets the design shall ensure non-scouring velocities at the point of discharge. Acceptable outlet velocities will depend on soil conditions, but should not exceed 2m/s without specific provision for energy dissipation and velocity reduction.

Where inlets or outlets are located on or near natural waterways their appearance in the riparian landscape and likely effect on in-stream values shall be considered. Methods could include cutting off the pipe end at an oblique angle to match soil slope, constructing a headwall from local materials such as rock or boulders, planting close to the structure, and locating outlets well back from the water’s edge.

Direct discharge to a waterway or the sea may require a discharge consent from the regional council unless authorised by a comprehensive consent held by the TA, or is a permitted activity in a regional plan.

4.3.9.8 Outfall water levels

Where a pipeline or waterway discharges into a much larger system the peak flows generally do not coincide. Backwater profiles should produce satisfactory water levels when assessed as follows:

(a) Determine the time of concentration and set the design rainfall event for the smaller system;

(b) Determine the peak flow for the design event;

(c) Determine receiving waterway peak water level for the design rainfall event in (a);

(d) Starting with the level from (c) determine the smaller system profile at a flow of 75% of the flow from (b);

(e) Determine the receiving waterway mean annual flood water level;

(f) Starting with the level from (e) determine the smaller system water profile at the flow from (b);

(g) Select the higher of the two profiles determined for design purposes.

Similarly, for tidal outfalls, peak flow may or may not coincide with extreme high tide levels. A full dynamic analysis and probability assessment may be required.

Sea level rise shall be taken into account (see 4.3.5.3).

4.3.9.9 Subsoil drains

Subsoil drains are installed to control groundwater levels. Perforated or slotted pipe used under all areas subject to vehicular traffic loads shall comply with NZTA specification F/2 and NZTA F/2 notes. It is good practice to provide regular inspection points.

Bedding and backfill material around a subsoil drain pipe shall be more free-draining than the in situ soil. If filter fabrics are used their susceptibility to clogging, thereby reducing the through flow, should be considered.

Groundwater control shall always be considered when an open drain is piped.

In the absence of any other more appropriate criterion the design flow for subsoil systems shall be based on a standard of 1 mm/h (2.78 L/s/ha).

Refer to manufacturer's literature for information on pipe materials, filter fabrics, bedding, and filter design.

4.3.9.10 Bulkheads for pipes on steep grades

Bulkheads, or anti-scour blocks, shall be detailed on the design drawings and shall be in accordance with Appendix B drawing CM – 003. Spacing of bulkheads shall be:

Table 4.4 – Spacing of bulkheads for pipes on steep grades

Grade (%)	**Requirement**	**Spacing (S)** (m)
15 – 35	Concrete bulkhead	S = 100/Grade (%)
>35	Special design	Refer to TA

NOTE – On grades flatter than above where scour is a problem, sand bags may be used to stabilise the trench backfill.

4.3.9.11 Trenchless technology

See 5.3.6.8 and 5.3.6.9 for guidance on the use of trenchless technology.

4.3.10 Manholes

4.3.10.1 Standard manholes

Access chambers or MHs shall be provided at all changes of direction, gradient and pipe size, at branching lines and terminations and at a distance apart not exceeding 100 m unless approved otherwise. They shall be easily accessible and located clear of any boundary. All public mains shall terminate with a MH at the upstream end.

See 5.3.8.2 and 5.3.8.3 of this Code of Practice for further guidance on the location of MHs.

On pipelines equal to or greater than 1 m diameter, the spacing of MHs may be extended with the approval of the TA.

Appendix B drawings CM – 004, CM – 005, and CM – 006 for manholes may be adopted for stormwater systems.

4.3.10.2 Manhole materials

MHs may be manufactured in concrete, or from suitable plastics materials, including glass reinforced plastic (GRP), polyethylene, PVC or polypropylene, or from concrete/plastic lined composites.

MH materials selected shall be suitable for the level of aggressiveness of the surrounding groundwater.

4.3.10.3 Size of manholes

The standard internal diameter of circular MHs is 1050 mm and preferred nominal internal diameters are 1050 mm, 1200 mm, and 1500 mm.

When considering the appropriate MH diameter, consideration shall be given by the designer to the base layout to ensure hydraulic efficiency and adequate working space in the chamber. Where the effective working space is reduced by internal drop pipes, a larger diameter may be required. Where there are several inlets, consultation with the TA on the layout of the chamber is recommended.

The base layout of MHs shall comply with 5.3.8.4.2 of this Code of Practice and Appendix B drawings CM – 004 and CM – 005.

4.3.10.4 Shallow manholes (or mini manholes)

The minimum internal diameter of a manhole shall be 1050 mm.

4.3.10.5 Hydraulic flow in manholes

In addition to the normal pipeline gradient all MHs on pipelines less than 1000 mm diameter shall have a minimum drop of 30 mm within the MH to compensate for the energy loss due to the flow through the MH. See 5.3.8.4.4 and 5.3.8.4.5 for further guidance.

4.3.10.6 Manhole connections

Open cascade is permitted into MHs over 2.0 m in depth and for pipes up to and including 300 mm diameter providing the steps are clear of any cascade. Other situations may be considered and require TA approval.

The bases of all MHs shall be benched and haunched to a smooth finish to accommodate the inlet and outlet pipe.

New inlet pipes shall be cut back to the inside face of the MH and provided with a smooth finish. All chambers are to be made watertight with mortar around all openings.

Minor pipelines connecting to a MH at or below design water level in the MH shall do so at an angle of not greater than 90^{o} to the main pipeline direction of inflow.

Minor pipelines connecting at above design water level may do so at any angle.

4.3.10.7 Flotation

In areas of high water table, all MHs shall be designed to provide a factor of safety against flotation of 1.25.

4.3.11 Connection to the public system

Where the connection of individual lots and developments are to the public system they shall meet the following requirements:

(a) Connection shall be by gravity flow via laterals to public mains or waterways, or to a roadside kerb, or swale, or rainwater tanks;

(b) All new urban lots shall be provided with individual service laterals, unless on-site disposal is approved by the TA;

(c) Each connection shall be capable of serving the whole of the lot. Where, for physical reasons, this is not practicable a partial service to the building area only may be acceptable (subject to approval of the TA);

(d) The minimum internal diameter of connections shall be:

  (v) 100 mm for residential lots

  (vi) 150 mm for commercial and industrial lots and connections serving two dwellings or residential lots

  (vii) 200 mm for connections serving three or more dwellings or residential lots (unless otherwise approved by the TA);

(e) The connection shall be of a type capable of taking the spigot end of an approved pipe;

(f) Where the stormwater pipeline is outside the lot to be served, a connection pipeline shall be extended to the boundary of the lot and be marked by a 50 mm x 50 mm timber stake extending to 600 mm above ground level and painted blue;

(g) Connection to stormwater systems such as vegetated swales, soakpits, or soakage basins is acceptable provided the system is approved by the TA;

(h) All connections to pipelines or MHs shall be sealed by removable caps until such time as they are required;

(i) Connections shall be indicated accurately on as-built plans. Location relative to boundaries, depth to invert and ground level shall be given as a minimum.

4.3.12 Connection of lateral pipelines to public mains

Factory made fittings shall be used for all connections to public mains up to 300 mm diameter. Connections to larger mains up to 750 mm diameter shall use properly manufactured saddles. Concrete bondage to the exterior of the main pipe is required.

A hole may be made in a 900 mm diameter and larger main to effect a connection. The connection shall be properly dressed and plastered from inside the main to ensure that no protrusions exist.

When the lateral being connected is larger than 300 mm in diameter it shall be connected at a MH.

4.3.13 Building over Council Infrastructure

No building shall be constructed over any stormwater drain, nor shall any structure foundation be located within a line extending at 45º from 150mm below the pipe invert to the ground surface, or within 1.5m either side of the pipe, without the specific approval of the Council.

The Council will only give approval to construct a building over a stormwater drain if;

I. It is impractical to construct a new main clear of the zone of influence; and
II. A manhole is installed within 10m of both sides of the building; and
III. The pipe runs in a straight line both vertically and horizontally between manholes;

and

IV. There are no connections under the building; and
V. The condition of the pipe is checked by closed circuit television survey prior to construction at the applicant’s cost and the pipe condition is approved as acceptable by Council;

and

VI. Structures straddling or founded within the above zone are designed by a Chartered Professional Engineer such that there is no loading from the building applied to the stormwater pipe;

and

VII. A memorandum of encumbrance is drawn up at the applicant's expense indemnifying the Queenstown Lakes District Council against any claims for damage caused by the presence, maintenance, replacement or upgrade of the stormwater pipe.

4.4 Approval of proposed infrastructure

The approval process for land development and subdivision design and construction and documents and supporting information on stormwater drainage infrastructure to be provided at each stage of the process shall be in accordance with section 1 of this Code of Practice.

4.4.1 Approval process

Stormwater infrastructure requires approval from the TA and unless the TA holds a comprehensive, or network consent for the catchment, consents from the regional council to discharge, divert, or dam water may also be required.

In these circumstances it is good practice:

(a) To consult with LAs prior to consent application;

(b) To lodge applications with LAs at the same time so that land use and water-related resource consents can, if required, be dealt with at a joint hearing under s. 102 of the RMA.

4.4.2 Information to be provided

Specific information to be provided on any concept plans or scheme plans for development or subdivision incorporating stormwater infrastructure shall include:

(a) The location of any natural waterways or wetlands within the site or in close proximity to a boundary. The location in plan and level of the water's edge and shoulder of the banks shall be indicated;

(b) Typical pre-existing and post development cross sections through any natural waterways or wetlands;

(c) The proposed proximity of buildings to the water's edge or the shoulder of the banks, or both;

(d) Clear identification of the extent of any river, stream, or coastal floodplains on, or in close proximity to the site and overland flow paths within the site; and

(e) The level datum.

TAs may require some of the information following, particularly (h) and (i), in order to assess possible effects of a proposed development.

Applications for design approval shall include the information outlined in 1.8 of this Code of Practice. In addition the following information shall be provided:

(f) A plan showing the proposed location of existing and proposed stormwater infrastructure and flow paths;

(g) Detailed long sections showing the levels and grades of proposed stormwater infrastructure in terms of datum;

(h) Details and calculations prepared which demonstrate that agreed levels of service will be maintained. All applications to develop within a flood plain shall be supported by detailed calculations and plans to determine the floodplain boundaries and building floor levels to meet the freeboard requirements in 4.3.5.2;

(i) Details and calculations prepared which clearly indicate any impact on adjacent area or catchment that the proposed infrastructure may have; and

(j) Operations and maintenance guidelines for any water quantity and or quality control structures shall be submitted to the TA for design approval along with other documents. The guidelines should describe the design objectives of the structure, describe all major features, explain operations such as recommended means of sediment removal and disposal, identify key design criteria, and identify on-going management and maintenance requirements such as plant establishment, vegetation control, and nuisance control.

4.5 Construction

4.5.1 Pipeline construction

The construction of pipelines shall be carried out in accordance with the requirements of AS/NZS 2032 (PVC), AS/NZS 2033 (PE), AS/NZS 2566 Parts 1 and 2 (all buried flexible pipelines), or AS/NZS 3725 (concrete pipes).

4.5.2 Trenching

Guidance is provided in Appendix B drawings CM – 001 and CM – 002.

Where a pipeline is to be constructed through areas with unsuitable foundations such material shall be removed and replaced with other approved material or alternatively, other methods of construction shall be carried out to the approval of the TA to provide an adequate foundation, and side support if required, for the pipeline.

4.5.3 Reinstatement

Areas where construction has taken place shall be reinstated to the condition required by the TA.

4.5.4 Inspection and acceptance

Pipe systems of 1200 mm diameter or less shall be inspected using closed circuit television (CCTV) prior to acceptance by the TA.

CCTV inspections and deliverables shall be in accordance with New Zealand pipe inspection manual and the requirements of the TA.

The TA may, at its discretion, also require a water test to be carried out. Testing shall be carried out as specified in Appendix C.

5 Wastewater

5.1 Scope

Where community specific guidelines are available these shall be taken into consideration throughout the design and construction of subdivisions and development.

This section sets out requirements for the design and construction of wastewater systems for land development and subdivision. Section 5 primarily addresses reticulated systems, but reference is also made to on-site wastewater systems where applicable.

If the scope of the development is sufficiently large to include its own pumping station, then reference should be made to WSA 04.

5.2 General

5.2.1 Objectives

The designer shall agree the approach to be taken for wastewater with the Council prior to commencing any work.

The objectives of the design are to ensure that the wastewater system is functional and complies with the requirements of the TA's wastewater systems.

In principle the wastewater system shall provide:

(a) A single gravity connection for each property;

(b) A level of service to the TA's customers in accordance with the authority's policies;

(c) Minimal adverse environmental and community impact;

(d) Compliance with environmental requirements;

(e) Compliance with statutory OSH requirements;

(f) Adequate hydraulic capacity to service the full catchment;

(g) Long service life with minimal maintenance and least life-cycle cost;

(h) Zero level of pipeline infiltration on commissioning of pipes;

(i) Low level of pipeline infiltration/exfiltration over the life of the system;

(j) Resistance to entry of tree roots;

(k) Resistance to internal and external corrosion and chemical degradation;

(l) Structural strength to resist applied loads; and

(m) 'Whole of life' costs that are acceptable to the TA.

5.2.2 Referenced documents and relevant guidelines

Wastewater designs shall incorporate all the special requirements of the TA and shall be in accordance with the most appropriate Standards, codes, and guidelines including those set out in Referenced Documents. Related Documents lists additional material that may be useful.

5.3 Design

5.3.1 Design life

All wastewater systems shall be designed and constructed for an asset life of at least 100 years. Some components such as pumps, valves, and control equipment may require earlier renovation or replacement. Refer to WSA 02 for the classification of life expectancy for various components in conventional gravity systems.

5.3.2 Structure plan

The TA may provide a structure plan setting out certain information to be used in design, such as flows, sizing, upstream controls, recommended pipe layout, or particular requirements of the TA. Where a structure plan is not provided, the designer shall determine this information by investigation using this Code of Practice and engineering principles.

5.3.3 Future development

Unless agreed in writing by the Council where further subdivision or development is allowed for within the current district plan upstream of the one under consideration the council shall require infrastructure to be constructed to the upper limits of the subdivision/development to allow for future connections.

The assessment of required capacity shall be on the basis of full development to the extent defined in the current district plan. Where infrastructure may service adjacent land then the full development to the extent defined in the current district plan of all the land that may be serviced by the infrastructure shall be included in the capacity calculations.

Where the new infrastructure being installed is required by Council to service future development then that infrastructure will be designed and constructed on the basis of full development to the extent defined in the current district plan.

The cost of increased infrastructure to service adjacent future development shall be agreed in writing with the Council's Asset Performance Team prior to commencing work.

5.3.4 System design

5.3.4.1 Catchment design

Pipes within any project area shall be designed to be consistent with the optimum design for the entire catchment area and any future extension of the system shall be accommodated. This may affect the pipe location, diameter, depth, and maintenance structure location and layout. Designers shall adopt best practice to ensure a system with lowest life-cycle cost.

Pipes shall be designed with sufficient depth and capacity to cater for all existing and possible development of the catchment. Where future extension of the pipe is possible, it may be necessary to carry out preliminary designs for large areas of subdivided and unsubdivided land. This design shall use safety factors defined by the TA for hypothetical subdivision and service for layouts to determine the necessary depth and diameter for an extension.

The designer shall be responsible for checking with the Council that the downstream network is adequate to accommodate the proposed subdivision/development.

5.3.4.2 Extent of infrastructure

Where pipes are to be extended in the future, the ends of pipes shall extend past the far boundary of the development by a distance equivalent to the depth to invert and be capped off, unless otherwise agreed to by the TA. This ensures that a future extension of the pipe does not require unnecessary excavation within lots or streetscapes already developed.

5.3.4.3 Topographical considerations

In steep terrain the location of pipes is governed by topography. Gravity pipelines operating against natural fall create a need for deep installations which may require trenchless installation. The pipe layout shall conform to natural fall as far as possible.

5.3.4.4 Geotechnical investigations

The designer shall take into account any geotechnical requirements determined under section 2 of this Code of Practice.

5.3.5 Design criteria

5.3.5.1 Design flow

The design flow comprises domestic wastewater, industrial wastewater, infiltration, and direct ingress of stormwater.

The design flow shall be calculated by the method nominated by the TA. In the absence of information from the TA the following design parameters are recommended:

(a) Residential flows

- (i) Average dry weather flow of 250 litres per day per person
- (ii) Dry weather diurnal PF of 2.5
- (iii) Dilution/infiltration factor of 2 for wet weather
- (iv) Number of people per dwelling 3;

> ***C5.3.5.1(a)***
>
> *For small contributing catchments, PFs can be significantly higher but, due to the requirement for a minimum pipe size of DN 150, such flows will not govern the design.*

(b) Commercial and industrial flows

Where flows from a particular industry or commercial development are known they should be used as the basis of design. Where there is no specific flow information available and the TA has no design guide, table 5.1 is recommended as a design basis. These flows include both sanitary wastewater and trade wastes and include peaking factors.

5.3.5.2 Hydraulic design of pipelines

The hydraulic design of wastewater pipes should be based on either the Colebrook-White formula or the Manning formula. The coefficients to be applied to the various materials are shown in table 5.2.

5.3.5.3 Minimum pipe sizes

Irrespective of other requirements, the minimum sizes of property connection and reticulation pipes shall be not less than those shown in table 5.3.

> ***C5.3.5.3***
>
> *For infill situations, particularly where upgrading of existing DN 100 connections in sound condition and at reasonable grades would be impractical, it is common practice for up to six dwelling units to use the existing connection. However, such connections would not normally be taken over as public pipes by the TA.*

Table 5.1 – Commercial and industrial flows

Industry type (Water usage)	**Design flow** (Litre/second/hectare)
Light	0.4
Medium	0.7
Heavy	1.3

Table 5.2 – Guide to roughness coefficients for gravity sewer lines

Material	**Colebrook-White coefficient k** (mm)	**Manning roughness coefficient** (n)
VC	1.0	0.012
PVC	0.6	0.011
PE	0.6	0.009 – 0.011
GRP	0.6	0.011
Concrete machine made to AS/NZS 4058	1.5	0.012
PE or epoxy lining	0.6	0.011
PP	0.6	0.009 – 0.011

NOTE –

(1) These values take into account possible effects of rubber ring joints, slime, and debris.

(2) The n and k values apply for pipes up to DN 300.

(3) For further guidance refer to WSA 02:1999 table 2.4; AS 2200 table 2; *Plastics pipes for water supply and sewage disposal* (Janson), Metrication: *Hydraulic data and formulae* (Lamont), or the *Handbook of PVC pipe* (Uni-Bell).

Table 5.3 – Minimum pipe sizes for wastewater reticulation and property connections

Pipe	**Minimum size** **DN** (mm)
Connection servicing 1 dwelling unit	100
Connection servicing more than 1 dwelling unit	150
Connection servicing commercial and industrial lots	150
Reticulation servicing residential lots	150
NOTE – In practical terms, in a catchment not exceeding 250 dwelling units, and where no pumping station is involved, DN 150 pipes laid within the limits of table 5.4 and table 5.5 will be adequate without specific hydraulic design.	

5.3.5.4 Limitation on pipe size reduction

In no circumstances shall the pipe size be reduced on any downstream section.

5.3.5.5 Minimum grades for self-cleaning

Self-cleaning of grit and debris shall be achieved by providing minimum grades specified in tables 5.4 and 5.5.

Table 5.4 – Minimum grades for wastewater pipes

Pipe size DN	**Absolute minimum grade** (%)
150	0.55
200	0.33
300	0.25

Table 5.5 – Minimum grades for property connections and permanent ends

Situation	**Minimum grade** (%)
DN 100 property connections	1.65
DN 150 property connections	1.20
Permanent upstream ends of DN 150, 200, and 300 pipes in residential areas with population ≤20 persons	1.00

5.3.5.6 Maximum velocity

The preferred maximum velocity for peak wet weather flow is 3.0 m/s. Where a steep grade that will cause a velocity greater than 3.0 m/s is unavoidable refer to WSA 02 for precautions and design procedures.

5.3.5.7 Gravity wastewater applications

See Appendix A for appropriate gravity pipe Standards for wastewater.

The pipe shall be designed to:

(a) Have adequate capacity, grades, and diameters;

(b) Have adequate grade for self-cleaning;

(c) Be deep enough to provide gravity service to all lots;

(d) Comply with minimum depth requirements to ensure mechanical protection and safety from excavation;

(e) Avoid all underground services, while maintaining all the necessary clearances; and

(f) Allow for various drops and losses through MHs.

5.3.5.8 Pressure and vacuum wastewater applications

The introduction of pressure or vacuum systems into a network requires approval from the TA. See Appendix A for appropriate pressure pipe and fittings Standards for wastewater. See also 5.3.12.

Design of pressure and vacuum wastewater applications shall consider the following:

(a) Selection of pipe material and PN class shall take account of design for dynamic operation stresses (fatigue), and water temperature. Refer to Plastics Industry Pipe Association of Australia Ltd (PIPA) guidelines for PVC and PE pipes (http://www.pipa.com.au), or WSA-07;

(b) Sump and pump design;

(c) Maintenance requirements;

(d) Access for servicing and maintenance.

5.3.6 Structural design

5.3.6.1 General

The design shall be in accordance with AS/NZS 2566.1, or AS/NZS 3725, including the structural design commentary AS/NZS 2566.1 Supplement 1. Details of the final design requirements shall be shown on the drawings.

5.3.6.2 Seismic design

All pipes and structures shall be designed with adequate flexibility and special provisions to minimise risk of damage during earthquake. Historical experience in New Zealand earthquake events suggests that suitable pipe options, in seismically active areas, may include rubber ring joint PVC or PE pipes. Specially designed flexible joints shall be provided at all junctions between pipes and rigid structures.

5.3.6.3 Structural consideration

Pipelines shall be designed to withstand all the forces and load combinations to which they may be exposed including internal forces, external forces, temperature effects, settlement, and combined stresses.

5.3.6.4 Internal forces

Pipelines shall be designed for the range of expected pressures, including transient conditions (surge and fatigue) and maximum static head conditions. In the case of transient conditions, the amplitude and frequency shall be estimated. Mains subject to negative pressure shall be designed to withstand a transient pressure of at least 50 kPa below atmospheric pressure.

5.3.6.5 External forces

The external forces to be taken into account shall include:

(a) Trench fill loadings (vertical and horizontal forces due to earth loadings);

(b) Surcharge;

(c) Groundwater;

(d) Dead weight of the pipe and the contained water;

(e) Other forces arising during installation;

(f) Traffic loads;

(g) Temperature (expansion/contraction).

The consequences of external forces on local supports of pipelines shall also be considered.

5.3.6.6 Geotechnical investigations

The designer should take into account any geotechnical requirements determined under section 2 of this Code of Practice. Where required, standard special foundation conditions shall be referenced on the drawings.

5.3.6.7 Pipe selection for special conditions

Pipeline materials and jointing systems shall be selected and specified to ensure:

(a) Structural adequacy for the ground conditions and water temperature;

(b) Water quality considering the lining material;

(c) Compatibility with aggressive or contaminated ground;

(d) Suitability for the geotechnical conditions;

(e) Compliance with the TA's requirements.

5.3.6.8 Trenchless technology

Trenchless technology may be preferable or required by the TA as appropriate for alignments passing through or under:

(a) Environmentally sensitive areas;

(b) Built-up or congested areas to minimise disruption and reinstatement;

(c) Railway and major road crossings;

(d) Significant vegetation;

(e) Vehicle crossings.

Wastewater pipes used for trenchless installation shall have suitable mechanically restrained joints, specifically designed for trenchless application, which may include integral restraint, seal systems, or heat fusion welded joints.

Trenchless installation methods may include:

For new pipes:

(f) Horizontal directional drilling (HDD) (PVC with restraint joint/fusion welded PE)

(g) Uncased auger boring/pilot bore microtunnelling/guided boring (PVC with restraint joint/fusion welded PE)

(h) Pipe jacking (GRP/vitrified clay (VC)/ reinforced concrete)

For pipe rehabilitation/renovation:

(i) Slip lining/grouting (PVC with restraint joint/fusion welded PE)

(j) Closefit slip lining (PVC with restraint joint/fusion welded PE)

(k) Static pipe bursting (PVC with restraint joint/fusion welded PE)

(l) Reaming/pipe eating/inline removal (PVC with restraint joint/fusion welded PE)

(m) Soil displacement/impact moling (fusion welded PE)

(n) Cured in place pipe (thermoset resin with fabric tube)

Any trenchless technology and installation methodology shall be chosen to be compatible with achieving the required gravity pipe gradient – refer to manufacturer's and installer's recommendations.

The following details including location of access pits and exit points shall be submitted to the TA for approval:

(o) Clearances from services and obstructions;

(p) The depth at which the pipeline is to be laid to ensure minimum cover is maintained;

(q) The pipe support and ground compaction;

(r) How pipes will be protected from damage during construction;

(s) Any assessed risk to abutting surface and underground structures.

C5.3.6.8

Further information on trenchless technologies may be found in 'Trenchless technology for installation of cables and pipelines' (Stein), 'Trenchless technology – Pipeline and utility design, construction, and renewal' (Najafi), and 'Guidelines for horizontal directional drilling, pipe bursting, microtunnelling and pipe jacking' (Australasian Society for Trenchless Technology).

5.3.6.9 Marking tape or pipe detection tape

Appropriate marking tape or detection tape shall be installed at the top of the embedment zone, or tied to the pipe during HDD, to aid future location of the pipe. Refer to AS/NZS 2032 section 5.3.15 and figure 5.1.

5.3.7 System layout

5.3.7.1 Pipe location

The preferred layout/location of pipes within roads, public reserves, and private property may vary and shall be to the requirements of each TA.

Pipes should be positioned as follows:

(a) Within the street according to the locally applicable utilities allocation code. In the absence of a code, a location clear of carriageways is preferred;

(b) Within public land with the permission of the controlling authority;

(c) Within reserves outside the 1 in 100-year flood area;

(d) Within private property parallel to front, rear, or side boundaries.

5.3.7.2 Materials

All pipes shall be PE 100, PVC (minimum class SN8) or rubber ring joint reinforced concrete and meet the relevant standards as listed in Table A1 of NZS4404:2010Acceptance of design documentation without separate written approval shall not constitute acceptance of an alternative material.

5.3.7.3 Pipes in reserves and public open space

Pipes in reserves and public open space shall be located in accordance with the TA's requirements.

Crossings of roads, railway lines, waterways, and underground services shall, as far as practicable, be at right angles.

5.3.7.4 Pipes in private property

Where pipes are designed to traverse any vacant or occupied public or private properties, the design shall as far as practicable allow for possible future building plans, preclude maintenance structures and specify physical protection of the pipe within or adjacent to the normal building areas and all engineering features (existing or likely) on the site, such as retaining walls.

The design shall allow access for all equipment required for construction and future maintenance. Except where obstructions or topography dictate otherwise, pipes shall run parallel to boundaries at minimum offsets of 1.0 m.

Where pipes are designed to traverse properties containing existing structures such as retaining walls, buildings, and swimming pools, the current and future stability of the structure shall be considered. Pipes adjacent to existing buildings and structures shall be located clear of the 'zone of influence' of the foundations. If this is not possible, protection of the pipe and associated structures shall be specified for evaluation and approval by the TA.

Where pipes to be vested to the TA are designed to traverse private properties, they should be protected by legal easements when required by the TA.

5.3.7.5 Minimum cover

Pipelines shall have minimum cover in accordance with the TA or utility owner's requirements. Where the TA does not have specific requirements, the minimum covers as described in AS/NZS 2566.2 may be used.

Cover in carriageways, footpaths and crossings shall be no less than 1m. Cover outside of the carriageway, footpaths, crossings or other trafficable areas shall be no less than 0.6m.

5.3.7.6 Horizontal curves

Horizontal curves shall only be used where authorised by the TA.

The term 'curved pipes' is used to describe either cold bending of flexible pipe during installation or small deflections at joints for rubber ring jointed flexible and rigid pipes. The radius of curvature and pipe deflection shall meet manufacturer's specifications. Curved alignments are used in curved streets to conform with other services and to negotiate obstructions, particularly in easements. The use of curves in locations other than curved street alignments shall be justified by significant savings in life-cycle cost. The straight line pipe is usually preferred as it is easier and cheaper to set out, construct, locate, and maintain in the future.

5.3.7.7 Vertical curves

Vertical curves may be specified where circumstances provide a significant saving or where maintenance structures would be unsuitable or inconvenient. The curvature limitations for vertical curves are the same as those for horizontal curves in 5.3.7.6.

5.3.7.8 Underground services

The location of underground services affecting the proposed pipe alignment shall be determined. Where pipes will cross other services, the depth of those services shall be investigated, and exposed where necessary. Services upstream of the project area may affect the design. A future extension of the pipe that will cross existing and proposed upstream services may determine the level for the current project infrastructure.

5.3.7.9 Clearance from underground services

Where a pipe is designed to be located in a road which contains other services, the clearance between the pipe and the other services shall comply with SNZ HB 2002, unless the TA has its own specific requirements.

For normal trenching and trenchless technology installation, clearance from other service utility assets shall not be less than the minimum vertical and horizontal clearances shown in table 5.6. Written agreement on reduced clearances and clearances for shared trenching shall be obtained from the TA and the relevant service owner.

Table 5.6 – Clearances between wastewater pipes and other underground services

Utility **(Existing service)**	**Minimum horizontal clearance for new pipe size ≤DN 300** (mm)	**Minimum vertical clearance**$^{(1)}$ (mm)
Gas mains	300$^{(2)}$	150
Telecommunication conduits and cables	300$^{(2)}$	150
Electricity conduits and cables	500	225
Drains	300$^{(2)}$	150

Water mains	1000(3)/600	500

NOTE –

(1) Vertical clearances apply when wastewater pipes and other underground services cross one another, except in the case of water mains when a vertical separation shall always be maintained, even when the wastewater pipe and water main are parallel. The wastewater pipe should always be located below the water main to minimise the possibility of backflow contamination in the event of a main break.

(2) Clearances can be further reduced to 150 mm for distances up to 2 m when passing installations such as poles, pits, and small structures, providing the structure is not destabilised in the process.

(3) When the wastewater pipe is at the minimum vertical clearance below the water main (500 mm) maintain a minimum horizontal clearance of 1000 mm. This minimum horizontal clearance can be progressively reduced to 600 mm as the vertical clearance increases to 750 mm.

5.3.7.10 Clearance from structures

Pipes adjacent to existing buildings and structures shall be located clear of the 'zone of influence' of the building foundations. If this is not possible, a specific design shall be undertaken to cover the following:

(a) Protection of the pipeline;

(b) Long term maintenance access for the pipeline; and

(c) Protection of the existing structure or building.

The protection shall be specified by the designer for evaluation and acceptance by the TA.

5.3.7.11 Bulkheads for pipes on steep grades

For bulkheads, or anti-scour blocks, see 4.3.9.10 and Appendix B drawing CM – 003.

5.3.8 Maintenance structures

5.3.8.1 General

This describes the requirements for structures which permit access to the wastewater system for maintenance.

The minimum internal diameter of a manhole shall be 1050 mm.

Maintenance structures include:

(a) Manholes (or maintenance holes) (MHs);

(b) Maintenance shafts (MSs); and

(c) Terminal maintenance shafts (TMSs).

5.3.8.2 Location of maintenance structures

The selection of a suitable location for maintenance structures may influence the pipe alignment. Generally, a minimum clearance of 1.0 m should be provided around maintenance structures clear of the opening to facilitate maintenance and rescue. The TA may determine other specific requirements subject to the individual site characteristics.

The design shall include maintenance structures at the following locations:

(a) Intersection of pipes except for junctions between mains and property connections;

(b) Changes of pipe size;

(c) Changes of pipe direction, except where horizontal curves are used;

(d) Changes of pipe grade, except where vertical curves are used;

(e) Combined changes of pipe direction and grade, except where compound curves are used;

(f) Changes of pipe invert level;

(g) Changes of pipe material, except for repair/maintenance locations;

(h) Permanent or temporary ends of a pipe;

(i) Discharge of a pressure main into a gravity pipe.

Table 5.7 summarises maintenance structure options for wastewater reticulation.

Table 5.7 – Acceptable MH, MS, and TMS options for wastewater reticulation

Application	Acceptable options(1)		
	MH	MS	TMS
Intersection of pipes(2)	YES	NO	NO
Change of pipe grade at same level	YES	YES for DN 150 pipe only and using vertical bend	NO
Change of grade at different level	YES MH with internal/external drops	NO	NO
Change in pipe size	YES MH is the only option	NO	NO
Change in horizontal direction	YES within permissible deflection at MH	YES MS prefabricated units or MS used with horizontal bends of max 33^{o} deflection	YES for DN 150 pipe only
Change of pipe material	YES	NO	NO
Permanent end of a pipe(3)	YES	YES	YES
Pressure main discharge point	YES MH is the only option and shall include a vent	NO	NO

NOTE –

(1) Where person entry is required down to the level of the pipe, a MH is the only option.

(2) This table refers to reticulation mains. DN 100 connections can be made to any maintenance structure or, using a proprietary junction, at any point along the main.

(3) Some TAs permit the use of London Junction or Rodding Eye at the end of the pipe, but it is recommended that TMSs are used.

5.3.8.3 Maintenance structure spacing

For reticulation pipes, the maximum distance between any two consecutive maintenance structures shall be 120 m.

At the permanent end of a wastewater main, the distance from the end maintenance structure to the nearest downstream MH shall not exceed 240 m (see figure 5.1).

Where a combination of MHs and MSs is used along the same pipe, the maximum spacing between any two consecutive MHs shall not exceed 400 m irrespective of how many MSs are used between the two MHs (see figure 5.2).

5.3.8.4 Manholes

5.3.8.4.1 Manhole materials

MHs may be manufactured in concrete, or from suitable plastics materials, including GRP, polyethylene, PVC or polypropylene, or from concrete/plastic lined composites.

MH materials selected shall be suitable for the level of aggressiveness of the wastewater and surrounding groundwater.

5.3.8.4.2 Base layout

Each MH base shall have:

(a) One minimum standing area of 350 mm x 350 mm or of 350 mm diameter (where the ladder or step irons are located), and a second minimum width standing area of 250 mm x 250 mm or of 250 mm in diameter, as shown in Appendix B drawing CM – 004;

(b) A minimum working space of 750 mm clear of drop pipes, ladders, and step irons; and

(c) Channels with a minimum inside channel wall radius of 300 mm (in plan).

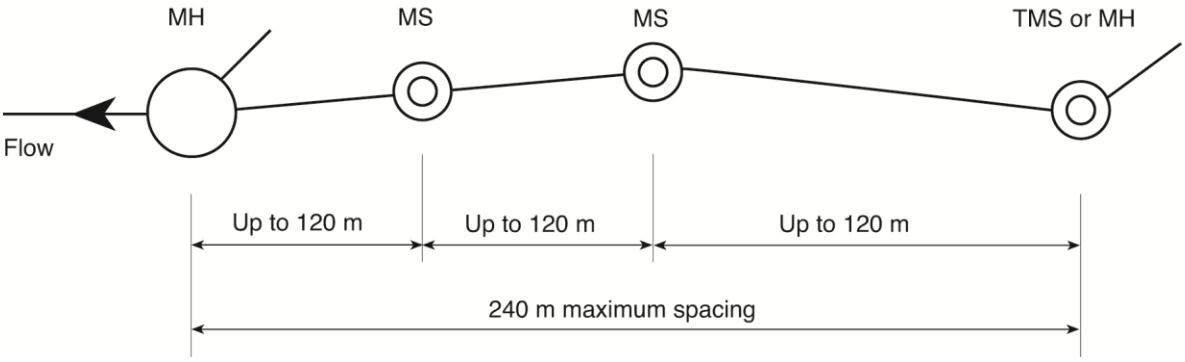


Figure 5.1 – Multiple MSs between MH and 'last' MH/TMS

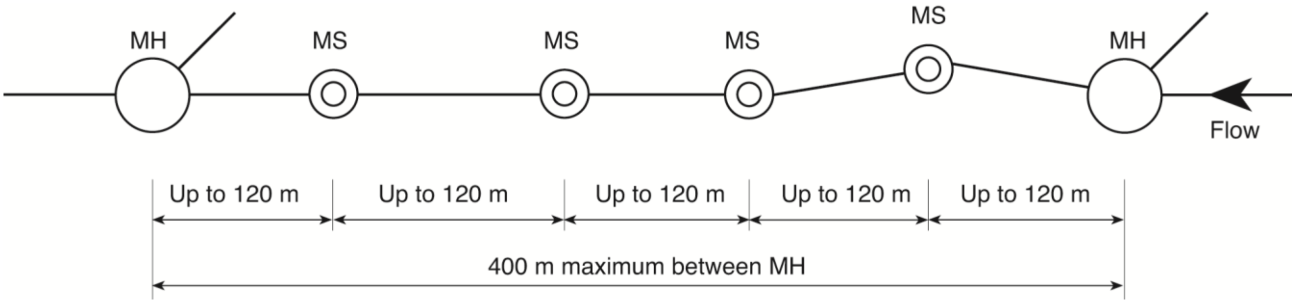


Figure 5.2 – Multiple MSs between consecutive MHs

5.3.8.4.3 Allowable deflection through MHs

A maximum allowable deflection through a MH shall comply with table 5.8.

The maximum distance between maintenance structures shall be 100m

5.3.8.4.4 Internal falls through MHs

The minimum internal fall through a MH shall comply with table 5.9.

Where the outlet diameter at a MH is greater than the inlet diameter, the minimum fall through the MH shall be not less than the difference in diameter of the two pipes, in which case the pipes shall be aligned soffit to soffit.

On pipes where the internal fall across the base of the MH is not achievable due to a large difference between the levels of incoming and outgoing pipes (see Appendix B drawing CM – 005), then internal or external drops shall be provided.

Table 5.8 – Maximum allowable deflections through MHs

Pipe size DN	**Maximum deflection** Degrees (°)
150 – 300	Up to 120° for internal fall along MH channel – see table 5.9
150 – 300	Up to 150° where there is a large fall at MH using an internal or external drop structure

Table 5.9 – Minimum internal fall through MH joining pipes of same diameter

Deflection angle at MH Degrees (°)	**Minimum internal fall** (mm)
0 to 30	30
>30 to 60	50
>60 to 120	80

5.3.8.4.5 Effect of steep grades on MHs

Where a pipe of grade >7% drains to a MH, the following precautions shall be taken if the topography and the connection pipes allow for:

(a) No change of grade is permitted at inlet to a MH;

(b) Steep grades are to be continuous through the MH at the same grade;

(c) Depth of MH is to exceed 1.5 m to invert for DN 150, DN 200, and DN 225 pipes;

(d) Depth of MH is to exceed 2.0 m deep for DN 300 pipes;

(e) Change of direction at the MH is not to exceed 45°;

(f) No drop junctions or verticals are to be incorporated in the MH;

(g) Inside radius of channel inside the MH is to be greater than 6 times the pipe diameter; and

(h) Benching is to be taken 150 mm above the top of the inlet pipe.

To avoid excessively deep channels within MHs, steep grades (>7%) shall be 'graded-out' at the design phase where practicable.

Grading the channel of the MH shall be limited to falls through MHs of up to 0.15 m. Where the depth of the channel within the MH would be greater than 2 x pipe diameter, then an internal or external drop structure shall be provided.

C5.3.8.4.5

> *For further guidance on handling steep grades, refer to WSA 02.*

5.3.8.4.6 Flotation

In areas of high water table, all MHs shall be designed to provide a factor of safety against flotation of 1.25.

5.3.8.4.7 Covers

Watertight MH covers with a minimum clear opening of 600 mm in diameter, complying with AS 3996, shall be used, unless the TA has an alternative standard. AS 3996 gives direction for the class of cover for particular locations and applications. (See Appendix B drawing CM – 004.)

5.3.8.4.8 Bolt-down covers

Where required by the TA, bolt-down metal access covers (watertight type) shall be specified on MHs:

(a) In systems where the possibility of surcharge exists; and

(b) Along creeks subject to flooding above the level of the cover, in tidal areas, or in any location where surface waters could inundate the top of a MH.

Sealed entry holes with restricted access should be used in geothermal conditions and for deep manholes.

MHs should, where practicable, be located on ground that is at least 300 mm above the 1 in 100-year flood level. Where this is not practicable, bolt-down access covers may be specified by the TA. It will also be necessary to specify the tying together of MH components where bolt-down covers are specified and precast components are used.

5.3.8.5 Maintenance shafts

Where maintenance shafts (MSs) have been approved by the TA, and where it is expected that human access below ground will not be required, MSs can be used on DN 150, DN 200, and DN 225 pipes as an alternative to MHs, providing 5.3.8.5.1 and 5.3.8.5.2 are satisfied. See Appendix B drawings WW – 001, WW – 003, and WW – 004.

Typical MS configurations are:

(a) Straight through MSs; and

(b) Angled MSs – see 5.3.8.5.2(a).

MSs can also be used in conjunction with a TMS (see 5.3.8.6).

5.3.8.5.1 Limiting conditions

The following conditions apply to the use of MSs:

(a) MSs shall only be used on DN 150, DN 200, and DN 225 pipes;

(b) MSs shall not be used instead of MHs at junctions;

(c) Depth of MSs shall:

  (i) Be within the allowable depth limit for the particular pipeline system

  (ii) Not exceed the MS manufacturer’s stated allowable depth limit, and

(iii) Be within the depth limit imposed by the TA;

(d) MSs shall be restricted to pipeline gradients and depths where the deviation from vertical of the MS riser shaft (that is, projected centre line of base to centre line at surface) is a maximum of 0.3 m measured at the surface;

(e) MSs shall not be used at discharge points of pumping mains.

5.3.8.5.2 Design parameters

MSs shall only be used at the design locations detailed in figures 5.1 and 5.2. The following requirements shall apply:

(a) Directional and gradient changes at MSs shall be achieved by using either:

(i) Close-coupled horizontal or vertical manufactured bends immediately adjacent to the MS (maximum horizontal deviation of 33°), or

(ii) MS units specially manufactured with internal horizontal or vertical angles to suit design requirements (maximum horizontal deviation of 90°);

(b) MSs at changes of grade shall be located on the pipe with the lesser of the two gradients to minimise the deviation from the vertical of the riser shaft;

(c) Straight through type and angled MSs can incorporate up to two higher level property connections discharging directly into the riser shaft.

For construction details see Appendix B drawings WW – 003 and WW – 004.

5.3.8.6 Terminal maintenance shafts

Where terminal maintenance shafts (TMSs) have been authorised by the TA and where it is expected that human access below ground will not be required, TMSs may be used on DN 150, DN 200, and DN 225 pipes as an alternative to MHs, providing the conditions detailed in this Code of Practice are satisfied.

For construction details see Appendix B drawing WW – 005.

5.3.8.6.1 Design parameters

A TMS may only be used as a terminating structure under the following conditions:

(a) At the permanent end of a wastewater pipe;

(b) On DN 150, DN 200, and DN 225 pipes;

(c) After the last MH (with no intermediate MS) provided it is spaced no further than 120 m from that MH, as shown in figure 5.1;

(d) After an intermediate MS, as shown in figure 5.2;

(e) Subject to the limiting conditions detailed in 5.3.8.5.1.

5.3.8.6.2 Property connections into a permanent end

TMSs may incorporate a maximum of two higher level property connection branches discharging directly into the riser shaft. Where a property connection is required directly ahead of the permanent end of the pipe (for example, a connection at the end of a no-exit road), a MS may be used instead of a TMS to accommodate the straight through connection. In such a case, a DN 100 connection will require a reducer immediately adjacent to the MS.

5.3.8.6.3 Dead ends

Pipes need not terminate at a MH, MS, or TMS if the pipe is to be extended in the future.

5.3.9 Venting

In urban developments, pipes will normally be adequately ventilated within private property. However, there are some situations where vent shafts will be required such as:

(a) At pumping stations;

(b) At MHs where pumping stations discharge to a gravity pipe; and

(c) At entrances and exits to inverted siphons.

In such situations vent shafts shall be installed as per the requirements of WSA 02 and WSA 04.

5.3.10 Connections

Connections link private systems to the public system or other approved outlet point. Private systems extend through to the public system, except where the TA accepts responsibility for that part of the pipe outside private property.

5.3.10.1 General considerations

The property connection should be designed to suit the existing situation and any future development. Each connection shall be capable of serving the entire building area of the property (unless specific approval is obtained from the TA).

5.3.10.2 Requirements of design

The design shall specify the requirements for the property connections including:

(a) Plan location and lot contours;

(b) Invert level at property boundary or junction with the main as applicable.

5.3.10.3 Number of connections

It is normal practice to provide one connection per lot. Provision of additional connections shall be subject to justification by the developer and approval by the TA.

For multiple occupancies (unit title, cross lease, or company lease), service of the whole property is normally achieved by providing a single point of connection to a TA system. Connection of the individual units is by joint service pipes owned and maintained by the body corporate, tenants in common or the company as the case may require. In this instance the whole of the multiple occupancy shall be regarded as a single lot.

Alternatively, if authorised by the TA, developers have the option of providing wastewater facilities to the individual titles or tenements in new developments by:

(a) Constructing individual connections which shall be owned and maintained by the body corporate, tenants in common or the company; or

(b) Extending the public line into the lot and providing a separate connection to each unit.

5.3.10.4 Location of connection

The connection shall be located to service the lowest practical point on the property and where possible:

(a) Be clear of obstructions, such as trees, tree roots, paved areas;

(b) Be easily accessible for future maintenance;

(c) Be clear of any known future developments, such as swimming pools or driveways;

(d) Avoid unnecessarily deep excavation >1.5 m where practicable;

(e) Be within or on the property boundary.

5.3.10.5 Connection depth

Connection depths shall be set to drain the whole serviced area recognising the following factors:

(a) Surface level at plumbing fixtures of buildings (existing or proposed);

(b) Depth to invert of pipe at plumbing fixture or intermediate points;

(c) Minimum depth of cover over connection for mechanical protection;

(d) Invert of public main at junction point;

(e) Allowance for crossing other services (for clearances see table 5.6);

(f) Provision for basements;

(g) Allowance for head loss in traps and fittings;

(h) Allowance for any soffit depth set by the TA.

The designed invert level at the end of the connection shall be not higher than the lowest calculated level consistent with these factors.

5.3.11 Pumping stations and pressure mains

Pumping stations and pressure mains shall be designed and installed in accordance with the standards of the TA. If the TA has no applicable standards, then they shall be designed in accordance with WSA 04.

Surge analysis and protection against surge pressures will be also required for wastewater pump/ pumping main system.

All products and components including pumps shall be approved by the Council prior to submitting a design for acceptance.
All pressure main pipework shall be PE 100.

5.3.12 Pressure sewers and vacuum sewers

Pressure sewers shall be designed and installed in accordance with the standards of the TA, with consideration in the design for cyclic dynamic stresses. Refer to the PIPA design guidelines (http://www.pipa.com.au). If the TA has no applicable standards, then they shall be designed in accordance with WSA 02 and WSA 07.

Vacuum sewers shall be designed and installed in accordance with the standards of the TA. If the TA has no applicable standards, then they shall be designed in accordance with WSA 06.

5.3.13 On-site wastewater treatment and disposal

On-site wastewater treatment and disposal shall be designed and installed in accordance with the standards of the TA. If the TA has no applicable standards, then they shall be designed in accordance with AS/NZS 1546.1 and AS/NZS 1547.

5.3.14 Building over Council Infrastructure

No building shall be constructed over any wastewater drain, nor shall any structure foundation be located within a line extending at 45º from 150mm below the pipe invert to the ground surface, or within 1.5m either side of the pipe, without the specific approval of the Council.

The Council will only give approval to construct a building over a wastewater drain if;

i. It is impractical to construct a new main clear of the zone of influence;

and

ii. A manhole is installed within 10m of both sides of the building;

and

iii. The pipe runs in a straight line both vertically and horizontally between manholes;

and

iv. There are no connections under the building;

and

v. The condition of the pipe is checked by closed circuit television survey prior to construction at the applicant's cost and the pipe condition is approved as acceptable by Council;

and

vi. Structures straddling or founded within the above zone are designed by a Chartered Professional Engineer such that there is no loading from the building applied to the wastewater pipe;

and

vii. A memorandum of encumbrance is drawn up at the applicant's expense indemnifying the Queenstown Lakes District Council against any claims for damage caused by the presence, maintenance, replacement or upgrade of the wastewater pipe.

5.4 Approval of proposed infrastructure

5.4.1 Approval process

Wastewater infrastructure requires approval from the TA.

5.4.2 Information to be provided

Applications for design approval shall include the information outlined in 1.8 of this Code of Practice. In addition the following information shall be provided:

(a) A plan showing the proposed location of existing and proposed wastewater infrastructure;

(b) Detailed long sections showing the levels and grades of proposed wastewater pipelines in terms of datum;

(c) Long sections shall include full details of pipe and manhole materials and sizes;

(d) Details and calculations prepared which demonstrate that agreed levels of service will be maintained;

(e) Details and calculations prepared which clearly indicate any impact on adjacent area or catchment that the proposed infrastructure may have; and

(f) Appropriate operating manuals, pump information, and instructions for pump stations and pressure systems if proposed.

5.5 Construction

5.5.1 Pipeline construction

The construction of pipelines shall be carried out in accordance with the requirements of AS/NZS 2032 (PVC), AS/NZS 2033 (PE), AS/NZS 2566 Part 1 and 2 (all buried flexible pipelines), AS/NZS 3725 (concrete pipes), or AS 1741 or BS EN 295 (VC).

5.5.2 Trenching

See Appendix B drawings CM – 001 and CM – 002 for guidance.

Where a pipeline is to be constructed through areas with unsuitable foundations such material shall be removed and replaced with other approved material or alternatively, other methods of construction shall be carried out to the approval of the TA to provide an adequate foundation and side support if required for the pipeline.

5.5.3 Reinstatement

Areas where construction has taken place shall be reinstated to a condition as required by the TA.

5.5.4 Inspection and acceptance

Pipeline inspection and recording by closed circuit television (CCTV) shall be carried out prior to acceptance by the TA.

CCTV inspections and deliverables shall be in accordance with *New Zealand pipe inspection manual* and the requirements of the TA.

5.5.5 Leakage testing of gravity pipelines

Before a new pipeline is connected to the existing system, a successful field test shall be completed. The test shall be carried out as specified in Appendix C.

5.5.6 Leakage testing of pressurised sewers

Requirements for field testing of pressurised sewers are given in Appendix C.

5.5.7 Connection to existing systems – add Clause

Connection to existing wastewater mains will only be undertaken by Queenstown Lakes District Council, or its authorised agents, at the cost of the applicant.

6 Water Supply

6.1 Scope

Where community specific guidelines are available these shall be taken into consideration throughout the design and construction of subdivisions and development.

This section sets out requirements for the design and construction of drinking water supply systems for land development and subdivision. It covers the design of both the localised reticulation system and the larger distribution network.

Water reticulation design is generally described in 'performance based' terms combined with 'deemed to comply' solutions. Individual TAs may specify additional or varying requirements. The designer is responsible for all aspects of the water system design, excepting those aspects nominated and provided to the designer by the TA.

If the scope of the development is large and includes its own water source, treatment or reservoirs, reference should be made to WSA 03.

Detailed plans and design calculations (where appropriate) shall be submitted to the TA. In addition the requirements outlined in section 1 of this Code of Practice shall be met.

6.2 General requirements

The designer shall agree the approach to be taken for water supply with the Council prior to commencing any work.

6.2.1 Objectives

The objectives are to ensure that the water reticulation system is functional, the required quality and quantity of water is supplied to all customers within the TA's designated water supply area, and the TA's requirements are satisfied.

The design shall ensure an acceptable water supply for each property including fire flows, depending on TA policies by providing either:

(a) A water main allowing an appropriate point of supply to each property; and

(b) A service connection from the main for each property.

The designer shall consider:

(c) The TA's policies, customer charters, and contracts;

(d) The hydraulic adequacy of the system;

(e) The ability of the water system to maintain acceptable water quality;

(f) The structural strength of water system components to resist applied loads;

(g) The requirements of SNZ PAS 4509;

(h) Environmental requirements;

(i) The environmental and community impact of the works;

(j) The 'fit-for-purpose' service life for the system;

(k) Optimising the 'whole-of-life' cost; and

(l) Each component's resistance to internal and external corrosion or degradation.

6.2.2 Referenced documents and relevant guidelines

Relevant legislation is listed in the Referenced Documents section of this Code of Practice.

Water designs shall incorporate all the special requirements of the TA and shall be in accordance with the most appropriate Standards, codes, and guidelines including those set out in Referenced Documents, the Civil Defence Emergency Management Act 2002, and *Drinking-water standards for New Zealand 2005* (Revised 2008). Related Documents lists additional material that may be useful.

6.3 Design

6.3.1 Design life

All water supply systems shall be designed and constructed for an asset life of at least 100 years. Some components such as pumps, metering, control valves, and control equipment may require earlier renovation or replacement. Refer to WSA 03 for the classification of life expectancy for various components of water supply systems.

6.3.2 Structure plan

The TA may provide a structure plan setting out certain information to be used in design, such as flows, sizing, upstream controls, recommended pipe layout, or particular requirements of the TA. Where a structure plan is not provided, the designer shall determine this information by investigation using this Code of Practice and engineering principles.

6.3.3 Future development

Unless agreed in writing by the Council, where further subdivision or development is allowed for within the current district plan adjacent to the one under consideration the council shall require infrastructure to be constructed to the extents of the subdivision/development to allow for future connections.

The assessment of required capacity shall be on the basis of full development to the extent defined in the current district plan. Where infrastructure may service adjacent land then the full development to the extent defined in the current district plan of all the land that may be serviced by the infrastructure shall be included in the capacity calculations.

Where the new infrastructure being installed is required by Council to service future development then that infrastructure will be designed and constructed on the basis of full development to the extent defined in the current district plan.

The cost of increased infrastructure to service adjacent future development will be agreed in writing with the Council's Asset Performance Team prior to commencing work.

6.3.4 System design

Water mains shall be designed with sufficient capacity to cater for all existing and predicted development within the area to be served and to meet the requirements of SNZ PAS 4509.

The designer shall be responsible for checking with Council that the network is adequate to accommodate the proposed subdivision/development.

The water demand allowance in the subdivision design shall include provision for:

(a) Population targets;

(b) The area to be serviced; or

(c) Individual properties proposed by the developer.

Adjustment may be required to cater for the known performance (demand-based flows) of the existing parts of the water system.

6.3.5 Design criteria

6.3.5.1 Hydraulic design

The diameter, material type(s), and class of the water main shall be selected to ensure that:

(a) The main has sufficient capacity to meet peak demands while maintaining minimum pressure;

(b) All consumers connected to the main receive at all times an adequate water supply and pressure; and

(c) The appropriate firefighting flows and pressures can be achieved.

6.3.5.2 Network analysis

Where required by the TA, a network analysis of the system shall be undertaken. The system shall be analysed using a mathematical model of the network to ensure adequate water supply is available to all consumers connected to the system for all defined modes of operation. The analysis shall include all elements within the system and shall address all demand periods including peak demand, low demand flows, and fire flows.

6.3.5.3 Peak flows

Water demands vary on a regional basis depending on a variety of climatic conditions and consumer use patterns. The TA should be able to provide historically-based demand information appropriate for design. Where peak demands are required for the design of a distribution system, the value shall be calculated from the following formulae:

Peak Day Demand (over a 12-month period) = Average Day Demand x PF

Unless specified otherwise by the TA:

(a) PF = 1.5 for populations over 10,000;

(b) PF = 2 for populations below 2,000.

Peak Hourly Demand = Average Hourly Demand (on peak day) x PF
(over a 24-hour period)

Unless specified otherwise by the TA:

(a) PF = 2 for populations over 10,000;

(b) PF = 5 for populations below 2,000.

6.3.5.4 Head losses

The head loss through pipe and fittings at the design flow rate shall be less than:

(a) 5 m/km for DN ≤150;

(b) 3 m/km for DN ≥200.

Head loss can be calculated using one of a number of standard hydraulic formulae. Some TAs have a preferred procedure and, where appropriate, this procedure should be used.

6.3.5.4.1 Hydraulic roughness values

The hydraulic roughness values considered in the analysis shall take account of the pipe material proposed, all fittings and other secondary head losses, and the expected increase in roughness over the life of the pipe. The designer should check with the TA to ascertain if it has any requirements to use a specific formula and or roughness coefficients. If there are no specific requirements then it is recommended that the Colebrook-White formula is used (see table 6.1). If the designer uses the Manning formula the coefficients in table 6.1 are recommended.

Table 6.1 – Hydraulic roughness values

Material	Colebrook-White coefficient **k** (mm)	Manning roughness coefficient (n)
PVC	0.003 – 0.015	0.008 – 0.009
PE	0.003 – 0.015	0.008 – 0.009
Ductile iron cement mortar lined	0.01 – 0.06	0.006 – 0.011
Mild steel cement mortar lined	0.01 – 0.06	0.006 – 0.011
GRP	0.003 – 0.015	0.008 – 0.009
NOTE – The values show a range of roughness coefficients. The lower value in the range represents the expected value for clean, new pipes laid straight. The higher value in the range represents the typical maximum expected for the product. It cannot be an absolute maximum, as the factors detailed in AS 2200 can lead to even higher roughness values in some circumstances. Recommendations on the appropriate roughness coefficient for a particular fluid may be obtained from the pipe supplier. Refer also to AS 2200 table 2 and notes.		

6.3.5.5 Minimum flows

The minimum flow shall be the greater of:

(a) 25 L/min for normal residential sites;

(b) Fire flows as specified in SNZ PAS 4509.

6.3.5.6 Minimum water demand

Following receipt of validated modelling data the daily consumption has been amended to

(a) Daily consumption of 700 L/p/day;

(b) Peaking factor of up to 4.0 (Queenstown), 6.6 (Rest of District);

(c) Firefighting demands as specified in SNZ PAS 4509;

(d) The network should be designed to maintain appropriate nominated pressures for both peak demand (average daily demand in L/s x peaking factor) and firefighting demand scenarios. These figures should be applied to mains of 100 mm diameter or greater. Mains less than 100 mm in diameter can be sized using the multiple dwellings provisions of AS/NZS 3500.1 table 3.2.

When supported by alternative modelling/metering data that has been approved by Council the following minimum water demand figures may be used at the sole discretion of the Council.

(a) Daily consumption of 250 L/p/day;

(b) Peaking factor of up to 4.0 (Queenstown), 6.6 (Rest of District);

(c) Firefighting demands as specified in SNZ PAS 4509;

(d) The network should be designed to maintain appropriate nominated pressures for both peak demand (average daily demand in L/s x peaking factor) and firefighting demand scenarios. These figures should be applied to mains of 100 mm diameter or greater. Mains less than 100 mm in diameter can be sized using the multiple dwellings provisions of AS/NZS 3500.1 table 3.2.

6.3.5.7 Sizing of mains

Tables 6.2 and 6.3 may be used as a guide for sizing mains.

Table 6.2 – Empirical guide for principal main sizing

Nominal diameter of main DN	**Capacity of main (single direction feed only)**			
	Residential (lots)	**Rural residential** (lots)	**General/light industrial** (ha)	**High usage industrial** (ha)
100	40	10	–	–
150	160	125	23	–
200	400	290	52	10
225	550	370	66	18
250	650	470	84	24
300	1000	670	120	35
375	1600	1070	195	55

Table 6.3 – Empirical guide for sizing rider mains

DN 50 Rider mains		
Pressure	**Maximum number of dwelling units**	
	One end supply	**Two end supply**
High > 600 kPa	20	40
Medium 400 – 600 kPa	15	30
Low < 400 kPa	7	15

6.3.5.8 Pressure zones

TAs may have maximum acceptable pressure requirements in any pressure zone. In some cases, a 'PRV zone' may be used to control the pressure delivered to an area. In these cases the designer shall consult with the TA to confirm pressure requirements.

6.3.5.9 Maximum pressure requirements

An output of the hydraulic design of a pipeline is the specification of the maximum pressure that may be imposed on the pipeline during operation.

Inputs to the design process include:

(a) Static head of supply;

(b) The range of pressure and flows required to provide an acceptable level of service to the end-user (minimum pressure) and to avoid water leakage (maximum pressure).

The outputs of water main hydraulic design shall include:

(c) Size of mains;

(d) Maximum and minimum design pressure;

(e) The pressure class/rating of pipeline system components;

(f) Surge analysis results;

(g) Hydraulic loss functions;

(h) Specification of the maximum allowable operating pressure;

(i) Flow and pressure compliance with peak demand and firefighting demand scenarios.

6.3.5.10 Design pressure

The design pressures are the limiting pressures for operation of a pipeline system including any allowance for variation of usage in the future.

The minimum design pressure is either the minimum pressure defined by the TA or some higher pressure selected to control (minimise) the range of pressures experienced over the normal diurnal variation in the system.

The design pressure shall be between 300 kPa and 900 kPa (30 m to 90 m).

A minimum pressure rating of each pipeline component is to be provided to the TA with the as-built details.

C6.3.5.10

A design pressure of 250 kPa to 800 kPa is set as this provides for approximately 200 kPa for two-storey dwellings at the upper floor and less than excessive pressures for dwellings constructed on lots below the position of the main. Specific additional consideration to these pressures may be needed in areas of significant contour.

6.3.5.10.1 Operating pressure/working pressure

The maximum allowable operating pressure in mains of 100mm dia and greater shall not exceed 900kPa without the specific approval of Council's Chief Engineer.

The maximum allowable operating pressure of ridermains and service connections shall not exceed 900kPa

6.3.6 Water quality

A number of factors in a network can adversely affect the quality of the water in the system. The network design shall ensure that the water quality at each property complies with the *Drinking-water standards for New Zealand 2005* (Revised 2008). The requirement to protect water supplies from the risk of backflow is stated in the Health

(Drinking Water) Amendment Act s. 69ZZZ and this shall be adhered to.

6.3.6.1 Materials

All parts of the water supply system in contact with drinking water shall be designed using components and materials that comply with AS/NZS 4020.

All pipes shall be HDPE 100. Unless otherwise agreed in writing by the Council. Acceptance of design documentation without separate written approval shall not constitute acceptance of an alternative material.

6.3.6.2 Prevention of backflow

Drinking water supply systems shall be designed and equipped to prevent backflow. The location and operation of hydrants, air valves, and scours shall ensure no external water enters the system through negative pressure from normal operation.

NOTE – Some TAs require appropriate backflow prevention at the point of supply for all connections.

6.3.6.3 Water age

Drinking water supply systems shall be designed to minimise water age to ensure no unacceptable deterioration of water quality. This shall include:

(a) Mains with dead ends should be avoided by the provision of linked mains or looped mains. Particular care shall be taken at the boundaries between supply zones where dead ends shall be minimised;

(b) Mains for short runs shall be reduced in size or looped, for example no-exit roads (see figure 6.5);

(c) Provision of large diameter mains capacity shall be staged by the initial provision of a smaller main, followed by additional mains as the demand increases. Discussions should be held with the TA on staging, as multiple mains may not be desirable and larger mains with a scouring programme may be preferred instead.

6.3.7 Flow velocities

In practice it is desirable to avoid unduly high or low flow velocities. Pipelines shall be designed for flow velocities within the range of 0.5 to 2.0 m/s. In special circumstances, velocities of up to 3.0 m/s may be acceptable.

For pumping mains an economic appraisal may be required to determine the most economical diameter of pumping main to minimise the combined capital and discounted pumping cost. The resulting velocity will normally lie in the range 0.8 m/s to 3.0 m/s.

The following factors shall be considered in determining flow velocity:

(a) Stagnation;

(b) Turbidity (large fluctuations in flow rates can dislodge the biological slime or stir up settled solids in pipelines);

(c) Pressure;

(d) Surge;

(e) Pumping facilities;

(f) Pressure reducing devices;

(g) Pipe lining materials.

6.3.7.1 Surge analysis

A surge analysis shall be undertaken for any pipeline within a pumped system or system containing automated valves. The source of any significant pressure surges or high-pressure areas shall be identified and remedial measures to minimise pressure surges designed and specified.

6.3.8 System layout

6.3.8.1 General

Water mains are usually located in the road. The location shall be specified by the TA, within the road or space allocation nominated by the road controlling authority. Where approved by the TA water mains may be located in private property or public reserve, and in this case easements shall be required.

Water mains should:

(a) Be aligned parallel to property boundaries;

(b) Should not traverse steep gradients; and

(c) Should be located to maintain adequate clearance from structures and other infrastructure.

(d) Where practicable water mains shall be laid in the road berm outside of the carriageway and any associated drainage features.

(e) All water mains shall be laid within legal public road reserves where practicable. Easements of a minimum width of 3.0m shall be provided for all water supply systems that are to be vested in Council or the system owner where they cross any private land.

6.3.8.2 Reticulation layout

A principal water main of not less than nominal internal diameter (DN) 100, fitted with fire hydrants, shall be laid on one side of all public roads and no-exit roads in every residential development. A DN 50 rider main shall be laid along the road frontage of all lots not fronted by the principal main. A DN 50 rider main shall also be provided for service connections where the principal main is DN 250 or larger. The principal mains serving commercial and industrial areas shall be at least DN 150 laid on both sides of the road. This requirement may be relaxed in short no-exit roads as long as adequate firefighting coverage is available.

6.3.8.3 Mains layout

In determining the general layout of mains, the following factors shall be considered:

(a) Main location to allow easy access for repairs and maintenance;

(b) Whether system security, maintenance of water quality, and ability to clean mains meet operational requirements;

(c) Location of valves for shut-off areas and zone boundaries (see 6.3.14);

(d) Avoidance of dead ends by use of looped mains or rider mains;

(e) Provision of dual or alternate feeds to minimise service risk.

6.3.8.4 Water mains in private property

Water mains located within private property will require an appropriately sized and registered easement in accordance with the TA's requirements.

> ***C6.3.8.4***
>
> *For some TAs, an easement over private property is not the preferred option and may only be used as a temporary solution for landlocked subdivisions pending future permanent supply within a road. A typical situation where the TA may approve water mains in easements is a fire main in a right of way.*

6.3.8.5 Types of system configuration

Network layouts shall be established in accordance with TA practice. Interconnected ring systems should be provided when feasible. Refer to WSA 03 for further information.

6.3.8.6 Water mains near trees

Locating water mains within the root zone of trees should be avoided if possible. Where this is not practicable, careful attention to pipe material selection is necessary to minimise risk of pipe failure due to root growth.

6.3.8.7 Shared trenching

Where shared trenching is approved by the TA and utility service owners, a detailed design shall be submitted for approval by those parties and shall include:

(a) Relative location of services (horizontal and vertical) in the trench;

(b) Clearances from other services;

(c) Pipe support and trenchfill material specifications;

(d) Embedment and trenchfill compactions;

(e) Trench markings;

(f) Services' location from property boundaries;

(g) Any limitations on future maintenance; and

(h) Special anchoring requirements, such as for bends and tees.

Where approved by the TA and utility service owners, shared trenching may also be used for property service connections.

6.3.8.8 Rider mains and duplicate mains

A rider main shall be laid along the road frontage of all lots not fronted by a principal main.

Duplicate mains are required to provide adequate fire protection in the following cases:

(a) Arterial roads or roads with a central dividing island;

(b) Roads with split elevation;

(c) Roads with rail or tram lines;

(d) Urban centres;

(e) Parallel to large distribution mains that are not available for service connections;

(f) Commercial and industrial areas nominated by the TA;

(g) Where required by SNZ PAS 4509.

6.3.8.9 Crossings

Water main crossings of roads, railway lines, and underground services shall, as far as practicable, be at right angles. Mains should be located and designed to minimise maintenance and crossing restoration. The TA may require extra mechanical protection for the pipes or different pipe materials to minimise the need for future maintenance.

6.3.8.10 Crossings of waterways or reserves

All crossings of waterways or reserves shall be specific designs to suit the TA's requirement.

Crossings shall, as far as practicable, be at right angles to the waterway or reserve. Reference should be made to the TA to establish whether it prefers elevated crossings or below waterway invert crossings. When the pipeline is placed under the invert level of a waterway it may require mechanical protection by concrete encasement or steel or other acceptable pipe duct. Different pipeline materials may need to be used for the crossing.

6.3.8.11 Location marking of valves and hydrants

The location marking of stop valves, service valves, and fire hydrants shall be to SNZ PAS 4509 and Appendix B drawing WS – 006.

6.3.9 Clearances

6.3.9.1 Clearance from underground services

Where a pipe is designed in a road the location of the pipe from other services shall comply with the Code as defined in 8.2.2, unless the TA has its own requirements.

For normal trenching and trenchless technology installation, clearance from other service utility assets shall not be less than the minimum vertical and horizontal clearances shown in table 6.4. Written agreement on reduced clearances and clearances for shared trenching shall be obtained from the TA and the relevant service owner prior to the commencement of construction.

Table 6.4 – Clearances between water mains and underground services

Utility (Existing service)	**Minimum horizontal clearance** (mm)		**Minimum vertical clearance**[1] (mm)
	New main size		
	DN ≤200	**DN >200**	
Water mains DN >375	600	600	500

Water mains DN ≤375	300(2)	600	150
Gas mains	300(2)	600	150
Telecommunications conduits and cables	300(2)	600	150
Electricity conduits and cables	500	1000	225
Public mains	300(2)	600	150(3)
Wastewater pipes	1000/600(4)	1000/600(4)	500(3)
Kerbs	150	600(5)	150 (where possible)

NOTE –

(1) Vertical clearances apply when water mains cross another utility service, except in the case of wastewater when a vertical separation shall always be maintained, even when the main and wastewater pipe are parallel. The main should always be located above the wastewater pipe to minimise the possibility of backflow contamination in the event of a main break.

(2) Clearances can be further reduced to 150 mm for distances up to 2 m when passing installations such as poles, pits, and small structures, providing the structure is not destabilised in the process.

(3) Water mains should always cross over wastewater and stormwater drains.

(4) When the wastewater pipe is at the minimum vertical clearance below the water main (500 mm), maintain a minimum horizontal clearance of 1000 mm. This minimum horizontal clearance can be progressively reduced to 600 mm as the vertical clearance is increased to 750 mm.

(5) Clearance from kerb and channel shall be measured from the nearest edge of the concrete. For water mains ≤375 clearances can be progressively reduced until the minimum of 150 mm is reached for mains DN ≤200.

(6) Where a main crosses other services, it shall cross at an angle as near as possible to 90°.

6.3.9.2 Clearance from structures

Pipes adjacent to existing buildings and structures shall be located clear of the ‘zone of influence’ of the building foundations. If this is not possible, a specific design shall be undertaken to cover the following:

(a) Protection of the pipeline;

(b) Long term maintenance access for the pipeline; and

(c) Protection of the existing structure or building.

The protection shall be specified by the designer for evaluation and acceptance by the TA.

Sufficient clearance for laying and access for maintenance is also required. Table 6.5 may be used as a guide for minimum clearances for mains laid in public streets.

Table 6.5 – Minimum clearance from structures

Pipe diameter DN	**Clearance to wall or building** (mm)
<100	600
100 – 150	1000
200 – 300	1500
375	2000
NOTE – These clearances should be increased for mains in private property (even with easements) as access is often more difficult and damage risk greater.	

6.3.9.3 Clearance from high voltage transmission facilities

Water mains constructed from metallic materials shall generally not be located close to high voltage transmission lines and other facilities. Special design shall be undertaken if it is necessary to locate such mains close to such facilities.

6.3.9.4 Deviation of mains around structures

Deviation of a pipeline around an obstruction can be achieved by deflection of the pipeline at joints, to the angular deflection limits stated by the pipe joint manufacturer and with suitably restrained fitting bends. Permitted angular deflection varies with pipe material, pipe wall thickness, pipe PN class, joint type, design and geometry. Some joint types are specifically designed to accommodate angular deflection. PVC and PE pipes may also be curved along the pipe barrel, between joints, to a minimum radius of curvature not less than that stated by the pipe manufacturer.

6.3.10 Pipe selection

The selection of the appropriate pipe material, sizes, and classes shall be based on system demands.

6.3.10.1 Standard pipe sizes

The principal main shall be standardised as DN 100, 150, 200, 250, 300, 375, 450, 525, 575, or 600 mm nominal diameter only. When larger pipes are required the exact diameter will be determined by the TA.

6.3.10.2 Minimum pipe sizes

Minimum pipe diameters shall be as follows, where DN is the nominal pipe diameter:

(a) DN 50 for rider mains in residential zones;

(b) DN 100 for residential zones;

(c) DN 150 for industrial or commercial zones.

The TA may also specify minimum pipe diameters for other identified areas such as CBDs.

6.3.10.3 Pipe PN class (pressure rating)

Pipe PN class is selected on the basis of the design pressure (head) calculated for the various sections of the reticulation network. This may be varied by specific operational requirements specified by the TA.

6.3.10.3.1 Design pressure

The design pressure (head) for the mains to be installed shall be based on the following:

Design pressure, (m)	=	Maximum Supply Pressure, (m above the level datum used for the ground level)
	+	Surge Allowance, (m) (see 6.3.7.1)
	–	Lowest Ground Level (GL) of the proposed main, (m above datum).

The design pressure (m head) shall be used for:

(a) Selection of pipe materials and classes;

(b) Selection of pipe fitting types and classes.

6.3.10.3.2 Minimum pipe PN

The minimum pipe and fittings PN to be used for water reticulation mains shall be PN 9 (see Appendix A for list of pressure pipe and fittings Standards). Designers shall verify the TA's minimum requirement before specifying the required pipe PN.

6.3.10.3.3 Nominated pipe PN

Some TAs may nominate a pipe PN (such as PN 12) for pressure pipes and fittings to standardise on a limited number of pipe PNs, or to allow future operational flexibility within their system. Where this is the case, the design pressure used as the basis for system design, anchorage, and pressure testing shall not exceed the TA's specified operating pressure limit associated with the pipe PN.

6.3.10.3.4 Pumped mains

For water mains in pumped systems, a detailed surge analysis shall be conducted unless otherwise directed by the TA to ensure:

(a) The appropriate surge pressure is included in the calculated design head;

(b) Surge control devices are included in the system design, where identified by the detailed analysis, to protect the network or control pressure fluctuations in the supply to customers, or both.

NOTE – Surge can also be managed by soft starts on pump motors, variable speed drives, and speed controls on valve closures, for example.

6.3.10.4 Pipe materials

For acceptable pipe materials and Standards see Appendix A.

6.3.11 Fire flow

The water reticulation system shall be designed to comply with SNZ PAS 4509.

6.3.11.1 Fire protection services

Many commercial and industrial developments require installation of special fire protection services. While it is the responsibility of the site owner to provide these fire services, the developer shall design the water reticulation system to meet the required demands, where these are known in advance.

6.3.12 Structural design

6.3.12.1 General

For installation conditions beyond those shown on the drawings, the pipeline installation shall be specifically designed to resist structural failure. The design shall be in accordance with AS/NZS 2566.1 including the structural design commentary AS/NZS 2566.1 Supplement 1. Details of the final design requirements shall be shown on the drawings.

6.3.12.2 Seismic design

All pipes and structures shall be designed with adequate flexibility and special provisions to minimise risk of damage during earthquake. Historical experience in New Zealand earthquake events suggests that suitable pipe options, in seismically active areas, may include rubber ring joint PVC pipes, or PE pipes. Specially designed flexible joints shall be provided at all junctions between pipes and rigid structures (such as reservoirs, pump stations, bridges, and buildings) in natural or made ground.

6.3.12.3 Structural consideration

Pipelines shall be designed to withstand all the forces and load combinations to which they may be exposed including internal forces, external forces, temperature effects, settlement, and combined stresses. The water main design shall include the selection of the pipeline material, the pipe class, and selection of appropriate bedding material to suit site conditions.

6.3.12.4 Internal forces

Pipelines shall be designed for the range of expected pressures, including transient conditions (surge and fatigue) and maximum static head conditions. In the case of transient conditions the amplitude and frequency shall be estimated. The allowance for surge included in the maximum design pressure shall not be less than 200 kPa. Transfer and distribution mains subject to negative pressure shall be designed to withstand a transient pressure of at least 80 kPa below atmospheric pressure. A surge safety factor of 2 may be applied to the normal operating pressure to estimate the surge pressure in lieu of a detailed surge analysis.

6.3.12.5 External forces

The external forces to be taken into account shall include:

(a) Trench fill loadings (vertical and horizontal forces due to earth loadings);

(b) Surcharge;

(c) Groundwater;

(d) Dead weight of the pipe and the contained water;

(e) Other forces arising during installation;

(f) Traffic loads;

(g) Temperature (expansion/contraction).

The consequences of external forces on local supports of pipelines shall also be considered.

6.3.12.6 Geotechnical investigations

The designer should take into account any geotechnical requirements determined under section 2 of this Code of Practice.

Where required, standard special foundation conditions shall be referenced on the drawings.

6.3.12.7 Pipe selection for special conditions

Pipeline materials and jointing systems shall be selected and specified to ensure:

(a) Structural adequacy considering ground conditions and water temperature;

(b) Water quality considering lining material;

(c) Compatibility with aggressive or contaminated ground;

(d) Suitability for the geotechnical conditions;

(e) Compliance with the TA's requirements.

6.3.12.8 Above-ground water mains

The design of above-ground water mains shall include the design of pipeline supports, maintenance and access requirements, control of unbalanced thrusts, and shall address exposure conditions, such as corrosion protection, UV protection, freezing of water mains, and temperature derating.

In such situations the pipe materials, support, and restraint for the pipes and fittings shall be detailed on the drawings.

6.3.12.9 Trenchless technology

Trenchless technology may be used as appropriate for alignments passing through or under:

(a) Environmentally sensitive areas;

(b) Built-up or congested areas to minimise disruption and reinstatement;

(c) Railway and major road crossings;

(d) Significant vegetation;

(e) Vehicle crossings.

Pressure pipes used for trenchless installation shall have suitable mechanically restrained joints, specifically designed for trenchless application, which may include integral restraint seal systems, or heat fusion welded joints.

For information on trenchless installation methods see 5.3.6.8.

> ***C6.3.12.9***
>
> *Further information on trenchless technologies may be found in 'Trenchless technology for installation of cables and pipelines' (Stein), 'Trenchless technology – Pipeline and utility design, construction, and renewal' (Najafi), and 'Guidelines for horizontal directional drilling, pipe bursting, microtunnelling and pipe jacking' (Australasian Society for Trenchless Technology).*

6.3.12.10 Embedment

6.3.12.10.1 Minimum pipe cover

Pipelines shall have minimum cover in accordance with the TA or utility owner's requirements. Where the TA does not have specific requirements, the minimum covers as described in AS/NZS 2566.2 may be used.

Cover in carriageways, footpaths and crossings shall be no less than 1m. Cover outside of the carriageway, footpaths, crossings or other trafficable areas shall be no less than 0.6m.

6.3.12.10.2 Minimum trench width

Pipe trench width design considerations shall be based on the minimum side clearances detailed in Appendix B drawing CM – 001.

6.3.12.11 Pipeline restraint

Anchorage shall be provided at bends, tees, reducers, valves, and dead ends where necessary.

> ***C6.3.12.11***
>
> *In-line valves, especially those DN 100 or larger, should be anchored to ensure stability under operational conditions. See Appendix B drawings WS – 001, WS – 002, WS – 003, WS – 004, and WS – 005.*

6.3.12.11.1 Thrust blocks

The design of thrust blocks shall be based on the maximum test pressure.

Thrust blocks shall be designed to resist the total unbalanced thrust and transmit all load to the adjacent ground. Calculation of the unbalanced thrust shall be based on the maximum design pressure, or as otherwise specified by the TA.

Restraint joint systems, specifically designed to resist the total unbalanced thrust, and support all thrust load, may be used, instead of thrust blocks. These may include mechanical restraint coupling joints, or integral restraint seal systems.

Typical contact areas for selected soil conditions and pipe sizes are shown in Appendix

B drawings WS – 004 and WS – 005.

Thrust blocks for temporary infrastructure shall be designed to the requirements for permanent thrust blocks.

6.3.12.11.2 Anchor blocks

Anchor blocks are designed to prevent movement of pipe bends in a vertical direction. They consist of sufficient mass concrete to prevent pipe movement (see Appendix B drawing WS – 005).

6.3.12.11.3 Restrained joint water mains

Commercially available mechanically restrained jointing systems may be used to avoid the need for thrust and anchor blocks subject to the approval of the TA. However many TAs will still require the use of thrust and anchor blocks.

6.3.13 Reservoirs and pumping stations

Where reservoirs or pumping stations are required, reference shall be made to the TA for its specific requirements.

WSA 03 contains design criteria for pumping stations and reservoirs.

6.3.14 Valves

6.3.14.1 General

All valves types, materials and manufactures shall be approved by the Council's Asset Performance Team prior to a design being submitted for acceptance.

Valves are used to:

(a) Isolate reticulation mains from distribution mains;

(b) Isolate smaller reticulation mains from larger reticulation mains;

(c) Isolate planning zone boundaries, for example, industrial, residential, or commercial.

Valves shall be provided:

(d) Each side of freeways, arterial roads, and railway and tram crossings;

(e) Adjacent to street intersections (for ease of location);

(f) In the footway, clear of roadway, where possible.

(g) A valve shall be located on all legs of a junction and positioned no further than 20m from the junction unless otherwise agreed with the Council.

Subject to these considerations, valve numbers shall be minimised.

The TA should be consulted to establish the local requirement for connection type (flange or socket), as well as any other issues such as valve anchoring requirements.

6.3.14.2 Siting of valves

The siting of valves shall take a holistic view of the existing infrastructure and proposed additions. General principles to be considered shall include:

(a) Valves shall be sited to provide the control (such as flow, pressure, isolation, and diversion) required by the TA;

(b) Ready access to valves to enable their safe operation. Account shall be taken of traffic and other site peculiarities;

(c) Minimisation of inconvenience to the public by avoiding clustering of surface fittings in the footpath at intersections;

(d) Optimisation of the number and location of valves to meet the TA's operation and maintenance requirements, safe working, and to minimise the effect of a shutdown on the TA's customers.

6.3.14.3 Gate valves

Valves shall have anti-clockwise rotation of the input spindle for closure, unless otherwise specified by the TA. Gate valves DN ≤50 (commonly called peet valves) shall be clockwise closing unless otherwise specified by the TA.

Buried gate valves shall be operated from above ground and shall be designed to facilitate the use of a standard key and bar. An extension spindle shall be incorporated as necessary to ensure the top of the spindle is 350 mm below the FSL.

Valves DN ≥80 shall be gate valves. In-line valves shall be the same diameter as the reticulation main.

6.3.14.3.1 Gate valve spacing criteria

The number of property service connections in a shut-off area shall be in accordance with table 6.6. When assessing property service numbers, unit title and strata title properties such as apartment buildings and multi-unit developments shall be counted as multiple connections. All connections having an alternative supply may be excluded when assessing property service numbers. The overriding maximum spacing between in-line valves shall be in accordance with table 6.6.

Table 6.6 – Valve spacing criteria

Water main size DN	**Number of property service connections (nominal)**	**Maximum spacing** (m)
≤150	40	300*
200-300	100	750
375	150	1000
* In rural areas, the maximum spacing is 500 m.		

6.3.14.3.2 Branch mains

Stop valves shall be located on branch mains adjacent to the through water main. The type of joint to be used (Soc-Soc, FI-Soc or FI-FI) shall be based on the required security of the water mains. For transfer mains or reticulation mains (≥ DN 300, a tee with a flanged branch, and a flanged valve shall be used (see figure 6.1 and Appendix B drawings WS – 001 and WS – 002).

Where a road crossing is necessary immediately after the tee branch and there is no space available adjacent to the tee, a stop valve shall be installed on the opposite side of the road (see figure 6.1 and Appendix B drawings WS – 001 and WS – 002).

6.3.14.3.3 Pressure zone dividing valves

Pressure zone dividing valves and hydrants shall be installed in one of the following arrangements (see figure 6.2):

(a) Valves in a paired configuration with a standard fire hydrant located between them. Installation in this manner permits the valves to be checked for leakage. The valve on the low pressure side of the pair will normally be closed in order for the fire hydrant to be used for firefighting purposes with the supply from the higher pressure zone;

(b) A valve with a standard fire hydrant on each side.

6.3.14.3. 4 Secure service connections

Additional stop valves may be provided at a service connection to a customer requiring a greater security of supply such as hospitals and large industrial or commercial developments. Figure 6.3 illustrates typical arrangements to facilitate partial isolation of the main while maintaining supply to the customer.

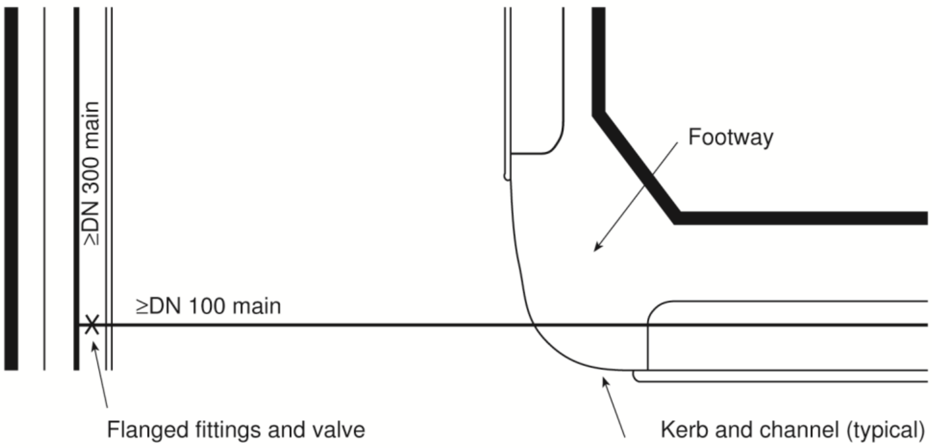


Figure 6.1 – Branch valve adjacent to main

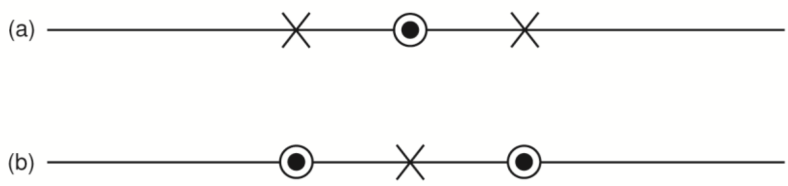


Figure 6.2 – Valve and hydrant combinations for pressure zone dividing valves

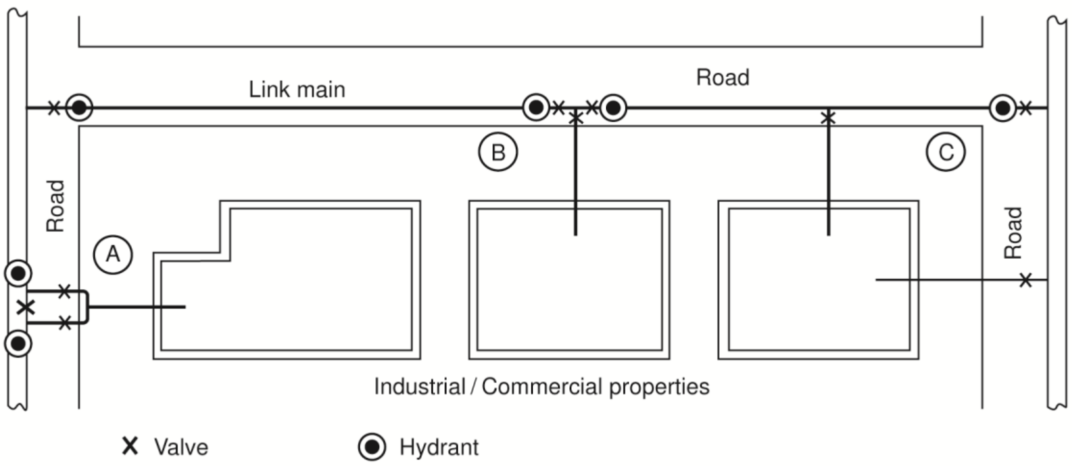


Figure 6.3 – Secure connection

NOTE –

(1) Example A – feed from two directions off a large diameter water main. The arrangement is more complicated than Example B, but is justified by the cost of an additional large diameter stop valve which would be required if using Example B.

(2) Example B – feed from two directions off a smaller diameter main. This is a simpler arrangement than Example A, but requires two valves on the main.

(3) Example C – feed from two separate mains.

6.3.14.4 Butterfly valves

Butterfly valves shall only be used with the approval of the TA.

> ***C6.3.14.4***
>
> *Butterfly valves are not normally used in reticulation mains as they hinder swabbing operations, and the quick closing action can induce high surge pressures.*

6.3.14.5 Pressure reducing valves

Pressure reducing valves (PRV) are outside the scope of this Code of Practice. Refer to WSA 03.

> ***C6.3.14.5***
>
> *A PRV is used to reduce the pressure upstream of the PRV to a desired lower downstream pressure. The PRV works automatically to maintain the desired downstream pressure. Refer to WSA 03 for design criteria.*

6.3.14.6 Air valves

6.3.14.6.1 Installation design criteria

Investigation into the need for air valves (AVs) shall be made for all high points on mains, particularly at points more than 2 m higher than the lower end of the section of water main and particularly if the main has a steep downward slope on the downstream side.

Where the hydraulic head is less than 10 m, special consideration shall be given to the type of AV to prevent water leakage from the valve. AVs shall be installed with an isolating valve to permit servicing or replacement without having to shutdown the main.

Combination AVs, that is (dual) AVs incorporating an AV (large orifice) and an air release valve (small orifice) in a single unit, are generally the preferred type for distribution and transfer mains, and where required on reticulation mains.

The nominal size of the large orifice of air valves shall be DN 80 for installation on mains. This size has an exhaust capacity of approximately 0.3 m^3/s.

> ***C6.3.14.6.1***
>
> *Water mains with only a few service connections or a configuration that leads to air accumulation may require combination air valves to automatically remove accumulated air that may otherwise cause operational problems in the water system.*
>
> *The configuration of the distribution network for both the change in elevation and the slope of the water main governs the number and location of air valves required.*

6.3.14.6.2 Air valves location

Air valves shall not be located in major roadways or in areas subject to flooding. When required, air valves shall be located:

(a) At summits (high points);

(b) At intervals of not more than 800 m on long horizontal, ascending, and descending sectors;

(c) At every increase in downward slope;

(d) At every reduction in upward slope;

(e) On the downstream side of PRVs;

(f) On the downhill side of major isolating valves;

(g) At blank ends.

Where the air valve is in a valve chamber, the design shall ensure adequate venting for effective operation and drainage to prevent backflow contamination.

6.3.14.7 Scours and pump-out branches

Scours and pump-out branches are provided in the distribution network for maintenance purposes. They are designed to allow draining of water from the mains by gravity or use of a mobile pump.

Hydrants may be used for flushing and draining on water mains DN <300.

C6.3.14.7

On mains DN ≥300, scours are more effective in draining and provide greater flushing velocities than hydrants.

Scours and pump-out branches shall incorporate appropriate measures to prevent back siphonage into the water supply system.

There shall be adequate drainage facilities to receive the flow resulting from flushing and draining operations.

Scours shall:

(a) Drain the water main by gravity or have provision for pump-out within a period of 1 hour, or both;

(b) Have a diffuser fitted at the discharge point if there is a likelihood of environmental or asset damage; and

(c) Not be subject to inundation.

6.3.14.7.1 Scour sizes

Scours shall be sized in accordance with table 6.7.

Table 6.7 – Minimum scour size

Main size DN	**Scour size** DN
DN ≤200	80

DN >200 – DN ≤300	100
DN >300 – DN ≤375	150

6.3.14.7.2 Scour locations

Scours shall be located at:

(a) Low points at the ends of water mains; and

(b) Low points between in-line stop valves.

Scours shall drain to a point where the discharge is readily visible to prevent the scour valve inadvertently being left open.

Typical discharge locations include:

(c) An approved pit that is to be pumped out each time the scour is operated (called a pump scour);

(d) A kerb and channel;

(e) An open-grated street drainage sump;

(f) A natural water course (with energy dissipater).

Scours shall not:

(g) Cause damage when operated;

(h) Discharge to closed stormwater structures;

(i) Discharge across roadways;

(j) Discharge directly to waterways, unless in compliance with the appropriate consent requirements.

6.3.14.8 Flushing points

Flushing points shall be installed at the end of DN 50 rider mains (see Appendix B drawing WS – 002).

6.3.15 Hydrants

6.3.15.1 General

Hydrants are installed on reticulation mains for firefighting or operational purposes. Operational purposes include mains flushing, chlorination, to allow the escape of air during charging, and the release of water during dewatering of the water main, where air valves and scours are not installed.

6.3.15.2 Hydrants for firefighting

The spacing of hydrants for firefighting shall be in accordance with SNZ PAS 4509.

6.3.15.3 Hydrant installation

Fire hydrants shall not be fitted to reticulation mains DN <100 or to distribution or transfer mains without the prior written approval of the TA.

6.3.15.4 Hydrants for reticulation system operational requirements

Additional to firefighting requirements, hydrants shall be provided at:

(a) High points on reticulation mains to release air during charging, to allow air to enter the main when dewatering, and for manual release of any build up of air, as required, where automatic combination AVs are not installed;

(b) Localised low points on water mains to drain the water main where scours are not installed.

Adequate drainage facilities shall be provided to receive the hydrant flows from dewatering and flushing operations.

> ***C6.3.15.4***
>
> *AVs are not normally required on reticulation mains in residential areas where the configuration of mains and service connections will usually eliminate small amounts of air accumulated during operation; hydrants should be placed as close as possible to stop valves to facilitate maintenance activities such as cleaning of water mains.*

6.3.15.5 Hydrants at ends of mains

If a scour is not provided, a hydrant shall be installed as close as possible to the end of every main DN ≥100.

> ***C6.3.15.5***
>
> *Apart from the firefighting function, a hydrant also allows the section of dead end main to be flushed regularly to ensure acceptable on-going water quality. This is particularly important in new subdivisions where only a small number of properties may be connected initially and where the main has been laid in a larger than required size with the expectation that it will be extended at a future date.*

6.3.16 Connections

6.3.16.1 Connection of new mains to existing mains

In specifying connection detail the designer shall consider:

(a) Pipe materials, especially potential for corrosion;

(b) Relative depth of mains;

(c) Standard fittings;

(d) Pipe restraint and anchorage;

(e) Limitations on shutting down major mains to enable connections; and

(f) Existing cathodic protection systems.

Connections from the end of an existing main shall be designed to address any differing requirements for the pipes being connected, particularly restraint, spigot/socket joint limitations, and corrosion protection. The designer shall consider the potential for insufficiently restrained/ anchored stop valves near the connection.

All connections to the existing reticulation shall be made by a contractor approved the TA.

6.3.16.2 Property service connections

Property service connections shall conform with the sizes permitted by the TA.

The method of connection (including tapping) is dependent on both the reticulation main and service connection pipe materials. The method adopted shall conform to:

(a) Appendix B drawing WS – 003;

(b) The requirements of the TA.

The position of the property connection toby valve, meter, and backflow device shall conform with the requirements of the TA.

Each Residential Unit shall be provided with a 20mm dia connection. The connection to each Residential Unit shall include a 20mm dia Acuflo Manifold including internal backflow prevention located within an Acuflo manifold box on the property boundary.

Except that for Multi-unit developments or multiple rear lots a rider main shall be provided from the road boundary with a valve at the road boundary and each Residential Unit shall be provided with an individual 20mm dia Acuflo Manifold including internal backflow prevention located within an Acuflo manifold box adjacent to the unit or lot boundary.

The Acuflo manifold box shall be extended and the Acuflo manifolds shall be located with 550-650mm cover to ground level for all 20mm connections. The toby valve for all other service connections shall be located with 550-650mm cover to ground level within a standard valve box.

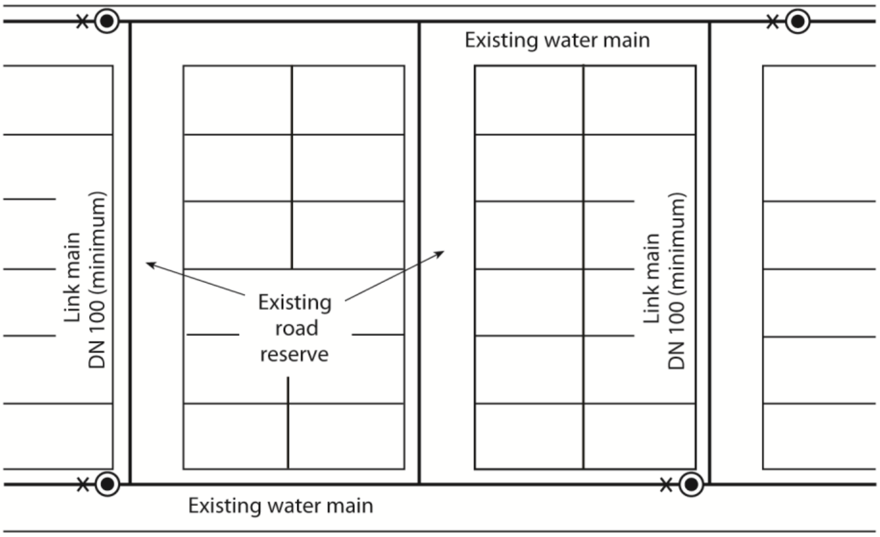
Valves shall be located clear of vehicle manoeuvring areas, where practicable. Where this cannot be achieved, the valve shall be protected within a pre-approved trafficable valve box.

Where the District Plan permits two or more Residential Units to be constructed on a single Lot, individual 20mm dia service connections shall be provided to each Residential Unit or one 25mm dia service connection for a maximum of two Residential Units. Each service connection shall be connected to the nearest trunk water main or rider water main. 25mm dia water connections shall be divided and reduced to a 20mm dia water connection to each Residential Unit served.

The connection of property service connections up to and including 50mm to water supply mains shall be made with “Talbot” isolation stopcocks on tapping bands.

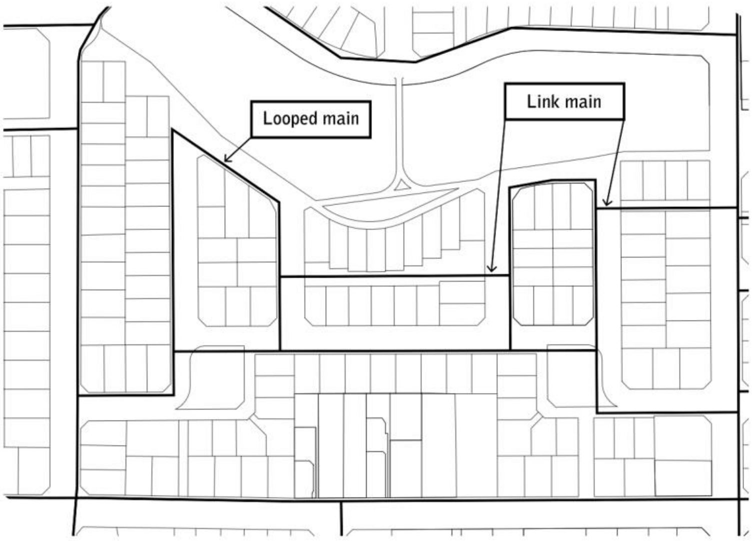
6.3.17 Termination points

Termination points or dead ends should be avoided to prevent poor water quality. Alternative configurations such as a continuous network, link mains, looped mains, and the use of reticulation mains smaller than DN 100, particularly in no-exit roads, should be considered (see figures 6.4 and 6.5).



NOTE – Rider mains are not shown.

Figure 6.4 – Elimination of termination points



Note - Rider mains are not shown

Figure 6.5 – Looped and link principal mains

6.3.17.1 Permanent ends of water mains

Rider mains, DN <100, may be used to supply the furthest properties beyond the water main. The DN 100 main shall be laid to a point where all properties are provided with the fire protection required by SNZ PAS 4509.

A method of flushing shall be provided at the end of the rider main and water main, which shall be suitably anchored (see Appendix B drawing WS – 002).

6.3.17.2 Temporary ends of water mains

Water mains shall be laid to within 1 m of the boundary of a subdivision where the main is to be extended in the future.

Temporary dead-end mains shall terminate with a hydrant followed by a gate valve. The valve and hydrant shall be suitably anchored so that the future extension can be carried out without the need to disrupt services to existing customers.

Where a development is staged mains shall be constructed to terminate approximately 2 m beyond the finished road construction to ensure that future construction does not cause disruption to finished installations.

6.3.18 Water Meters and Backflow Prevention

Water meters shall be installed by the developer at all points of supply on the property boundary and must be accessible to pedestrians. Once installed and following 224c certification the meters are owned and maintained by QLDC.

All meters shall be in accordance with QLDC's water metering policy or as agreed in writing by QLDC's Asset Planning and Asset Performance teams.

6.3.19 Building over Council Infrastructure

No building shall be constructed over any water supply pipe, nor shall any structure foundation be located within a line extending at 45º from 150mm below the pipe invert to the ground surface, without the specific approval of the Council.

The Council will only give approval to construct a building/structure over a water main if;

i. It is impractical to construct a new main clear of the zone of influence;
and
ii. A valve is installed within 10m of both sides of the building;
and
iii. The pipe runs in a straight line both vertically and horizontally between valves;
and
iv. There are no connections under the building;
and
v. The condition of the pipe is checked pot holes every 10m prior to construction at the applicant's cost and the pipe condition is approved as acceptable by Council;
and
vi. Structures straddling or founded within the above zone are designed by a Chartered Professional Engineer such that there is no loading from the building applied to the water main;
and
vii. A memorandum of encumbrance is drawn up at the applicant's expense indemnifying the Queenstown Lakes District Council against any claims for damage caused by the presence, maintenance, replacement or upgrade of the water pipe.

6.4 Approval of proposed infrastructure

6.4.1 Approval process

Water supply infrastructure requires approval from the TA.

6.4.2 Information to be provided

Design drawings compatible with the TA's concept plan and the design parameters included in this Code of Practice shall be provided to the TA for approval. Designers shall ensure the following aspects have been considered and where appropriate included in the design:

(a) The size (or sizes) of pipework throughout the proposed reticulation system;

(b) Selection of appropriate pipeline material type/s and class;

(c) Mains layouts and alignments including:

- (i) Route selection
- (ii) Topographical and environmental aspects
- (iii) Easements
- (iv) Foundation and geotechnical aspects
- (v) Clearances, shared trenching requirements
- (vi) Provision for future extensions;

(d) Hydraulic adequacy including:

- (i) Compliance with the required maximum and minimum operating (working) pressure
- (ii) Acceptable flow velocities, and
- (iii) Compliance with the estimated water demand, including firefighting;

(e) Property service connection locations and sizes;

(f) Types and locations of appurtenances, including:

- (i) Stop valves
- (ii) Pressure reducing valves (PRVs)
- (iii) Hydrants and fire services
- (iv) Scours and pump-out branches and
- (v) Termination details;

(g) Locations and details of thrust blocks and anchors, see Appendix B drawings WS – 004 and WS – 005;

(h) Preparation of final design drawings, plans (and specifications if applicable).

6.5 Construction

6.5.1 Excavation

Excavation of existing carriageways shall conform to the TA's road opening procedures where these exist. Excavation in existing carriageways shall be carried out in a safe manner with the minimum disruption to traffic and pedestrians.

6.5.2 Embedment

Pipes and fitting shall be surrounded with a suitable bedding material in accordance with Appendix B drawings CM – 001 and CM – 002.

6.5.3 Backfilling and reinstatement

6.5.3.1 Carriageways

Backfilling shall be in accordance with the requirements of the TA.

Pipe trenches within a carriageway shall be backfilled using an approved hardfill placed immediately above the pipe embedment and compacted in layers not exceeding 200 mm in loose depth, as per Appendix B drawing CM – 002.

In existing sealed roads, the top section of the trench shall be backfilled as specified by 3.4.2.3. The depth of base course and type of finishing coat seal shall conform to the standard of the existing road construction.

6.5.3.2 Berms

Pipe trenches under grass berms and footpaths shall be backfilled in accordance with the requirements of Appendix B drawing CM – 002.

6.5.3.3 Detector tape

Open trenching – backfill shall be placed to 100 mm below existing ground level. At this point, where required by the TA, the contractor shall provide and lay metallic 'detector' tape coloured blue, stipulating 'Danger – Water Main Below' (or similar). See Appendix B drawing CM – 001.

6.5.3.4 Tracer wire

Tracer wire in the form of a continuous 4 mm^2 multi strand (minimum 4) polythene sleeved copper cable, shall be installed with all non-metallic pipes to allow detection. The wire shall be strapped to the pipe wall by means of a minimum of two complete wraps of heavy duty adhesive tape, at a maximum of 3.0 m intervals. The wire shall have some slack to allow for bends in laying and for future installation of tapping saddles.

The tracer wire shall run continuously between valves and hydrants. At each valve or hydrant the wire shall be ducted to surface level through a length of polyethylene pipe ending immediately below the lid, The tracer wire shall be long enough to extend 600 mm minimum above ground level when uncoiled. The excess length shall be neatly coiled in the valve or hydrant box.

The tracer wire shall be tested for continuity between surface boxes using an electronically generated tone and detector probe or alternative approved method.

6.5.4 Pressure testing of water mains

Before a new water main is connected to the existing reticulation, a successful pressure test shall be completed. The system test pressure is applied to test the integrity of construction of the pipeline system. The system test pressure generally exceeds the actual design pressure of the system (maximum 1.25 times the maximum rated operating pressure of the lowest rated component in the system). See Appendix C for the appropriate testing procedure.

6.5.5 Disinfection of water mains

Disinfection of the water mains shall be carried out following successful pressure testing and backfilling as specified in Appendix D. The disinfection solution shall be collected and disposed of in an appropriate manner.

6.5.6 Discharge of testing water

Discharge of testing or chlorinated water from pipelines may require a resource consent from the regional council.

6.5.7 Water sampling

The TA may require water samples to be taken for water quality compliance purposes.

7 Landscape

7.1 Scope

Where community specific guidelines are available these shall be taken into consideration throughout the design and construction of subdivisions and development.

This section sets out requirements for the design and construction of landscape and planting for land development and subdivision. Section 7 applies to all landscape areas requiring planting and revegetation whether in road reserves, swales, rain gardens, ponds/wetlands, recreation reserves, or other public reserves, and private land.

7.2 General

Consultation with Queenstown Lakes District Council's Operations [Parks] department is required on all landscape matters in potential reserves prior to the design phase and development plan approvals. This includes consulting on the potential to create new reserve land and/or improve existing reserves. Public land for reserves shall only be created and vested in Council where there is an identified need in consultation with Council's Operations [Parks] department.

7.2.1 Approval

Consultation with the Council on landscape design and construction at an early stage, and prior to submission of any engineering designs for acceptance, is required.

Each TA may have specific landscape guidelines which will be detailed in district plans or codes of practice and some areas may be subject to special landscape requirements which will need assessment through a resource consent process. These may be subject to specific design consideration and approval by the TA. Stormwater systems including secondary flow paths shall be considered when landscape designs are determined, so as to avoid conflict or failure of these systems.

7.2.2 Environmentally-responsive design

Landscape design has application throughout the subdivision and development process. Landscape design should be considered in the early stages of a development and at this initial concept stage it is important to establish objectives for overall landscape design involving the appropriate professionals to assess the natural systems, vegetation, and landscape features. This includes consideration of protecting, maintaining, and restoring existing natural ecosystems, vegetation, and landscape features; responding to the surrounding landscape character and context; and cultural and heritage elements; and contributing to ecological and habitat biodiversity. Provision of amenity open space and access is required to make open space connections, access to and location of watercourses, and provision of reserves and streetscape to provide a framework of coherence and amenity.

7.2.3 Reserves and land protection covenants

Queenstown Lakes District Council's requirements for new reserve provisions should be determined prior to the initial design stage through consultation with the Operations [Parks] department.

When assessing reserve provision and development proposals the Council will consider:

- Filling existing gaps in reserve provisions
- Encouraging improvement of existing reserves
- Development designs that are sympathetic to the existing landscape character of the area
- Development designs that will provide recreational benefit to the community and/or District
- Preserving existing lookout and observation points
- Protecting heritage features and sites
- Protecting and enhancing sites of ecological importance
- Securing reserve land at the subdivision stage(s) of development.

Council may request recreation, landscape, heritage or ecological assessments for consideration.

If new reserve land is considered appropriate, layout plans showing proposed location of reserves are required to be approved by Queenstown Lakes District Council's Operations [Parks] department prior to an application for an outline development plan, a plan change, a resource or building consent or a connection to Council services being lodged.

All reserve provision and development proposals should be approved in principle by Queenstown Lakes District Council's Operations [Parks] department prior to any public consultation.

Detailed development plans for all future reserves shall be submitted with applications for subdivision consent, and no work is to be carried out on site before approval of the development plans from Council's Operations [Parks] department. No work is to be carried out until development contributions have been calculated and agreed with Council. Council agreements relating to individual stages of development will allow work to commence on those stages.

All reserve development shall be completed in accordance with the plans acceptable to Queenstown Lakes District Council's Operations [Parks] department. 'As-built' plans shall be provided for all reserves. Development may include earthworks, drainage, irrigation, planting, paths, structures (such as seating, tables, lighting, rubbish bins, fencing, barriers, signs, and play equipment) and facilities (such as toilets and changing sheds) as agreed with Council's Operations [Parks] department.

7.2.4 Ecological, functional, and aesthetic opportunities

Planting provides a range of ecological, functional, and aesthetic opportunities for environmental enhancement:

(a) Ecological:

(i) Provides, protects, and maintains terrestrial biodiversity and habitat

(ii) Reduces the amount of sediment and pollutants entering waterways

(iii) Maintains and enhances water quality and habitat

(iv) Reduces surface water flooding

(v) Increases stability and contributes to erosion control

(vi) Supports carbon sequestration

(vii) Supports ecosystem functioning including nutrient recycling, water retention, purification, and sediment control

(viii) Provides wildlife habitat value;

(b) Functional:

   (i) Defines space
   (ii) Provides shade, shelter, and privacy
   (iii) Screens unsightly outlooks and provides visual barriers
   (iv) Ameliorates sound and reduces pollution
   (v) Assists driver recognition of road link and place context
   (vi) Reduces glare and reflection and provides urban cooling
   (vii) Assists in the control of erosion
   (viii) Creates physical barriers
   (ix) Provides recreation and amenity value
   (x) Provides edible species
   (xi) Provides opportunities for enhancing health, and should not be detrimental to it;

(c) Aesthetic:

   (i) Frames views
   (ii) Emphasises landform and landscape features
   (iii) Provides visual unity in the environment
   (iv) Reduces the visual impact of the roadway
   (v) Softens hard surfaces and bleak areas
   (vi) Provides colour, form, and texture
   (vii) Provides visual lineage within and between regions
   (viii) Provides identity and environment.

7.2.5 Landscape and planting opportunities

Opportunities for landscaping are diverse, ranging from specimen tree planting to planting associated with existing indigenous vegetation, traffic management devices, riparian margins, wetlands, swales, rain gardens, ponds, reserves, and specific landscape features in the development.

7.3 Design

Planting and other landscaping shall be appropriate to and compatible with the local environment. The design layout and plant species selection shall be based on the consideration of the following:

- Ability of plants to thrive on the site
- Height of plants at time of maturity and future shading impacts
- Size of planting areas, including road berms, to be compatible with plant species
- To be sympathetic to the existing landscape character of the area
- Provide for long-term sustainable management.

Planting and other landscaping features shall be easily maintainable and minimise overall life cycle costs inclusive of establishment, irrigation, maintenance and replacement.

7.3.1 Location

Landscaping and planting should be designed to respond to the overall environmental context such as vegetation and water bodies, cultural and heritage elements, local road geometry, stormwater and reserve design, and utilities placement. Planting may include specimen trees, edible gardens, rain gardens, swales, and other amenity garden features. Refer to the Queenstown Lakes District Council Street Tree Planting Guidelines.

Infrastructural services should be planned at the same time as the landscape design so that tree and garden planting location does not compromise the integrity and efficient operation of services. If particular landscape conditions or objectives are required for a subdivision or development then these will need to be taken into account prior to undertaking detailed engineering design.

Detailed development plans showing distances of trees from paths, structures and underground services shall be provided for the approval of Queenstown Lakes District Council's Operations [Parks] department so as to reduce the potential for future conflicts between trees and infrastructure. All trees and vegetation planted near high voltage transmission lines must comply (including when maturity is reached) with the Electrical (Hazards from Trees) Regulations 2003

7.3.2 Reserve location and layout

Reserve location and layout design shall take into account adjoining land uses and areas to ensure there is an appropriate provision of recreation assets and landscaping in accordance with TA's plans and policies. The design of access routes into and through a reserve should ensure linkages with existing networks, consider future developments both of the reserve and adjoining areas, take into account topography, and shall follow CPTED principles.

7.3.3 Existing vegetation and trees

Where there is existing vegetation and/or trees in an area proposed as reserve, Queenstown Lakes District Council's Operations [Parks] department shall decide whether they are to be removed or retained prior to development and Arboricultural and/or Ecological assessments shall be provided on Council's request to inform this decision. Vegetation and/or trees to be removed or retained shall be identified on the development plans.

All existing vegetation and trees to be retained shall be cordoned off to protect the root zone and vegetation, prior to the commencement of construction and the cordon shall remain in place until completion of construction.

Existing trees to be retained are to be protected by temporary fencing in a circle with a radius equal to the maximum crown extension (drip line). A qualified person shall be used to determine the protected area and supervise construction. At no time shall anything be deposited in the root zones of protected vegetation and trees. If installation is required under existing vegetation trenchless technology should be considered, if this is not practicable advice from a suitably qualified person should be sought to minimise damage to the vegetation.

A tree or vegetation plan and construction methodology shall be supplied to the TA including:

(a) Position and design of temporary protective fencing or other methods of protection;

(b) Arboricultural maintenance required;

(c) Methods of protection of the tree and root zone where construction is to occur near the root zone and tree canopy;

(d) Maintenance required for long term health and stability of the tree or vegetation.

7.3.4 New trees and road geometry

Separation and sight distances should be considered when planting on roads. Alternative location and design proposals shall also be considered, such as provision of trees in a dedicated area or 'non-services' berm in the road reserve. Tree planting in groups can help accentuate road perception (see 3.3.5). Strategically placed, grouped plantings of trees are often of greater benefit and impact than individual trees placed linearly in a roadside berm.

7.3.5 Planted grass areas, berms, swales, or rain gardens

Berms, swales, or rain gardens shall be of sufficient width to allow for adequate growth of the plants and ease of maintenance. Narrow grass strips should be avoided. It is important to provide adequate means for tree growth and ongoing tree health at the same time as allowing for infiltration of water.

7.3.6 Species selection

In selecting species for planting, take into account the overall composition, low maintenance, and longevity, as well as the need to comply with the TA's planting policies.

Refer to the Queenstown Lakes District Council Street Tree Planting Guidelines.

Fruit trees and native tree species suitable to the environment shall be promoted in reserves, where appropriate.

The spacing of trees and plants should ensure a coherent design. The following matters shall be considered:

(a) Suitability of eco-sourced native plants for revegetation planting of the ecological region to protect the local biodiversity;

(b) Suitability to environmental conditions, for example climate, ground moisture, wind, and shade;

(c) Tolerance to high foot traffic use where appropriate;

(d) Pest and disease resistance, invasive or recognised as a pest plant under the National Pest Plant Accord (refer to http://www.biosecurity.govt.nz/nppa);

(e) Non-suckering habit;

(f) Final height, form, and longevity;

(g) Maintenance requirements;

(h) Safety such as toxicity of leaves, flowers, seeds, and bark in areas likely to be used by young children, and impairments to pedestrians;

Plant species on the road should be selected to avoid interfering with sight lines inconsistent with the target operating speed. The mature size of any tree or garden planting is to be assessed for each planting location and relative to the surrounding street environment.

7.3.7 Quality control

All plants shall be sound, healthy, vigorous, and free of any defects which may be detrimental to plant growth and development. In addition plants should have vigorous root and branch systems and plants supplied in pots should not be root bound. To ensure that plants adapt and thrive once planted they should be ‘hardened off’ prior to planting. Only species adapted to the site conditions shall be planted.

7.3.8 Landscaping structures

7.3.8.1

Landscaping structures include (but are not limited to) sculptures, walls, fences, screens, bollards, tree cages, entranceways, and posts. The materials should be robust to suit their purpose and ideally reflect the local character. The design of the landscape structure shall be considered as an integral part of the development and surroundings to fulfil both functional and aesthetic requirements. Durability and maintenance requirements shall be considered. Structures shall not:

(a) Inappropriately limit safe sight lines;

(b) Be a hazard to pedestrians, people with disabilities, cyclists, or vehicle traffic.

7.3.8.2

Entranceway wall structures shall be located fully on private land unless TA approval is obtained. Any other immovable landscape structure (for example boulders) shall be located to prevent obstructing access to underground services.

7.3.8.3

Structures shall be designed to safely withstand appropriate loadings. Structures not exempt under the Building Act shall only be constructed on receipt of a building consent.

Playground equipment shall comply with NZS 5828 and SNZ HB 5828.1.

All retaining walls including those not requiring a building consent should be constructed to resist lateral earth pressures and those from any surcharge loading that may be present.

7.3.9 Fencing of reserves

The permanent fencing of common boundaries of any reserve including esplanade, reserve accessways, and road boundaries, may be required. Standards and requirements shall be in accordance with the TA's fencing policy at the time. The TA may specify that one or both of the following options apply:

(a) A fencing covenant is registered on all titles of properties with a common boundary to reserve land, indemnifying the TA against all costs of erection and maintenance of fences on common boundaries;

(b) There is a specific fencing design for the reserve or boundary type.

7.3.10 Planting period and irrigation

Planting programmes where possible shall occur in the season that optimises growing conditions for plants and trees and maximises plant establishment.

Depending on the location and season of planting, Queenstown Lakes District Council's Operations [Parks] department may require provision for temporary irrigation of native gardens, grass areas or revegetation planting. Provision for watering during the establishment of plants or lawn may be required for these areas if not otherwise irrigated. Grass areas in reserves in CBDs or shopping precincts, sports field turf and all specimen trees and exotic gardens shall be permanently irrigated and irrigation plans shall be supplied for approval by Council's Operations [Parks] department.

7.4 Construction and maintenance

7.4.1 Introduction

There are minimum construction and maintenance standards and recommended procedures to be followed to ensure that all landscaping is to an acceptable standard prior to final inspection and release of the bond, if a bond is required.

It is the developer's responsibility to ensure that the landscaping meets the required standards at the termination of the maintenance period. The developer is responsible (and may be bonded) for the routine maintenance and replacement of the planting including dead wooding, weed control, mulching, replacing dead trees, shrubs, and plants, and watering for a defined period from the time of acceptance of as-built landscape plans by the TA or issue of a s. 224 completion certificate under the Resource Management Act.

Sign-off for practical completion shall be obtained from the Queenstown Lakes District Council's Operations [Parks] department at the end of the maintenance period. Maintenance and plant replacement shall be undertaken until sign-off. Prior to sign-off, grass and planting areas shall have a fully established sward of grass or planting coverage without any visible gaps. There should be no weeds present in the planting areas, and weed species should consist of no more than 5% of grass areas. All trees should be in good health, structure, form and be free of disease.

7.4.2 Soil and fertility

The developer shall be responsible for the supply and spreading of soil. Topsoil should be correctly stored and handled when stripped and respread. A soil test shall be undertaken to determine the composition and type of fertiliser to be applied to the area being developed. A proprietary fertiliser or soil ameliorant suited to the species shall be applied where the existing soil is deficient in minerals and nutrients, plants are showing signs of lack of fertility, or to ensure maximum health and vigour.

Application rates and type of fertiliser or soil ameliorant should be selected according to species and soil fertility.

7.4.3 Weeds and litter control

At the end of the maintenance period there shall generally be no weeds within 2 m of any tree planting or in garden beds. Weeds should be controlled in an appropriate manner. When hoeing/pulling weeds care shall be taken to avoid damage to plants and their roots. The soil shall not be mixed with mulch when removing weeds. Any spraying should be kept to a minimum near swales, rain gardens, ponds, riparian margins, and adjacent properties.

All areas once established shall be kept free of litter and debris, including paper, plastic, stones, bricks, bottles, glass, cans, and other forms of inorganic matter.

7.4.4 Planting grass areas

7.4.4.1

Grass areas and berms shall be formed after all other construction has been completed. The grass areas and berms shall incorporate not less than 100 mm compacted thickness of friable weed and stone free topsoil (generally made up of a compositions of approximately 1 – 5% sand, 7 – 16% humus or organic material, and no more that 30% weight in clay) placed over a base material capable of allowing root penetration and sustaining growth. The maximum slope for grass areas intended to be mown is 1:5.

7.4.4.2

Heavily compacted soils shall be ripped to a depth of 300 mm with rip lines 1 m apart, and rolled, before any laying of topsoil. The ground profile shall be smooth and free of ruts and depressions prior to grassing. Ripping to decompact soils should not be undertaken within the dripline of trees to be retained. Grass areas and berms shall be graded to edges (for example, pavement or footpath) allowing for approximately 15 mm of settlement.

7.4.4.3

Rural berms shall be topsoiled to the same standards as urban berms unless they make use of already grassed undisturbed ground.

7.4.4.4

The area for grass seeding shall be free of all weed species. Grass seed mix shall be in accordance with the Queenstown Lakes District Council Turf Reinstatement Specifications, January 2007.

7.4.4.5

A sward coverage of not less than 90% shall be achieved within 1 month of sowing, and before completion documentation shall be provided for processing by the TA. All established grass shall be mown to a range specified by the TA. A common mowing height range is a minimum height of 50 mm and maximum height of 100 mm. All grass edges shall be maintained in a neat and tidy manner.

7.4.5 Mulch

7.4.5.1

Mulch shall be applied to tree and garden areas to conserve moisture and reduce weed growth, except in riparian margins. Typically mulch will be cambium grade bark mulch, clean, free of sawdust and dirt, and with individual pieces no larger than 100 mm; mulched trees/branches that have no viable seeds; or stone mulches. Mulch for planting beds shall be a uniform 100 mm in final depth. Edges shall be formed to hold the mulch without spillage on to adjacent surfaces. Before mulching soil should be damp to a depth of 300 mm. Mulching should be carried out on an ongoing basis to all garden beds and juvenile trees to maintain specified depth at end of maintenance period.

7.4.5.2

Mulch shall only be spread after the soil surface is levelled off to remove bumps and hollows. Weeds and grass are to be removed prior to mulching. Plants shall not be damaged or buried during the mulching process. Where it is known that bark mulch affects certain species or will be lost due to wind, slope of the land, or for some other reason, alternative mulches shall be considered and used.

7.4.5.3

Mulch shall be evenly spread at the base of the trunk and shall not be stacked into a volcano shape.

7.4.6 Specimen tree planting

7.4.6.1

Specimen trees are defined as trees with a trunk diameter of 25 mm to 100 mm when measured at 1400 mm above ground level. Larger trees can be used with the approval of the TA.

Those contractors involved in specimen tree planting and maintenance should be competent horticultural/ arboricultural practitioners and therefore follow accepted industry standard procedures for tree planting. Establishment and initial maintenance are critical to the long-term viability of the specimen tree.

7.4.6.2

Specimen trees shall be sound, healthy, vigorous, and free of any defects (relative to the species). Specimen trees are to be a minimum of PB 95 (planter bag of 95 pint capacity approximately 54 L) grade when planted. A recommended minimum height for specimen trees is 2.5 m at the time of planting to aid early establishment unless the local conditions of a site require consideration of alternatives, for example, an exposed site may require small, well-hardened trees. Specimen trees between 1.5 – 2.5 m may be allowed with the approval of the TA.

7.4.6.3

Given the generally modified nature of soil in subdivisions it is essential that a suitable tree planting pit be prepared. The approach shall be to have:

(a) Ground free from debris and rubbish;

(b) Ground cultivated to a depth of 1 m and a width of 1 m to break up any compaction, fracture subsoil, and afford drainage to hard rock areas;

(c) Sides of planting holes crumbled and not smooth;

(d) Topsoil incorporated into the upper level of planting holes;

(e) Each tree fertilised with an appropriate amount of slow release fertiliser, as per the manufacturer's recommendations;

(f) Final planted depth consistent with finished ground level;

(g) Each tree adequately staked to withstand movement in natural wind conditions and to meet TA standards;

(h) Trees secured with expandable ties at approximately 1/3 of their height or as high as required to support the tree (to be checked every 6 months) or anchored below ground with a root ball anchor;

(i) Soil firmed sufficiently to force any air pockets from planting holes;

(j) Trees watered immediately following planting;

(k) Trees radially mulched to a distance of 500 mm or to drip line, whichever is the greater area and a depth of 100 mm; and

(l) Staking uniformly low and visually consistent throughout the subdivision stage. Ground-treated timber stakes should only be used if the stakes are to be removed once the trees are stable, that is at the end of a maintenance period.

7.4.6.4

The onus is on the developer to ensure that trees are protected during the further development of the subdivision (that is, the construction of dwellings/buildings) and during the defined maintenance period.

7.4.7 General amenity planting

Before topsoil is added all stripped and graded ground intended for planting should be cultivated to a depth appropriate to the plant species including a sufficient depth to break up any compaction. There should be friable topsoil for shrubs and ground cover appropriate to the depth of the root ball.

7.4.8 Revegetation planting and existing vegetation

Revegetation planting shall be a minimum grade of PB3 (planter bag) or root trainers and shall be planted at a density and size of plant that achieves a coverage ratio specified by the TA or appropriate to form the desired canopy density. Plants shall be spaced unevenly in the planting layout to encourage a natural appearance and setting.

Assisted natural revegetation is a technique using native seedling establishment complemented with weeding, thinning, and mulching and is an option that may be considered.

Edges of existing vegetation, to be retained where appropriate, shall be planted to mitigate the effects of wind funnelling. Mulches can be used in these areas to minimise the establishment of weed species.

7.4.9 Swales, rain gardens, wetlands, and riparian margins planting

Swales, rain gardens, wetlands, and riparian margins should have site specific planting plans prepared by a suitably qualified person and submitted to the TA for approval of designs. Access shall be provided if future removal and maintenance is required.

7.4.10 Pruning

7.4.10.1

Trees should be selected and located to minimise ongoing pruning costs and requirements. All pruning of street trees shall be undertaken by a suitably qualified arborist. All pruning shall be undertaken to recognised arboricultural practices.

Pruning should be carried out on shrubs to maintain a high standard of presentation, display, and plant vigour. Paths, roads, and all other accessways should be kept clear of excess growth. Pruning may also be necessary to ensure signs are not obscured. Where appropriate pruning should allow for adequate sight visibility to ensure the safety of road users. However there are situations where planting should be used to restrict visibility and slow traffic or frame views.

7.4.10.2

All weak, dead, diseased, and damaged growth should be removed, and pruning carried out to maintain the desired shape and size. Pruning should not be carried out during leaf burst or leaf fall. The following pruning techniques (for shrubs) should be employed where appropriate:

(a) Tips to be pinched or purged as appropriate for species to give desired shape and size;

(b) Form pruning of young plants to ensure compact form and shape;

(c) Undercutting of groundcovers at edges generally;

(d) Plants are to be pruned so that they do not smother neighbouring plants.

7.4.11 Maintenance

7.4.11.1

Landscape plans shall ensure that future maintenance requirements have been considered so that ongoing costs are minimised. The maintenance period will vary depending on the nature type of planting and should be covered in specifications and as required by the TA.

The developer shall:

(a) Remove from the area all temporary services, machinery, and surplus materials that have been used for the construction, and leave the site in a tidy condition;

(b) Clean all paths and surrounding areas;

(c) Remove all plant labels;

(d) Clear and weed all channels;

(e) Ensure that all damaged, vandalised, stolen, or dead plants are replaced to maintain numbers and unity of display;

(f) Ensure that amenity planting beds are cleaned to remove prunings, dead or damaged leaves, and any other object or material, including retail attachments such as labels. The edges of the beds shall be left evenly shaped and sloped.

Land to be vested for reserves purposes shall as a minimum meet the following general requirements:

(g) The land is to be free of noxious weeds, tree stumps (above ground) and other specified vegetation;

(h) All previous fences, farm utilities, building remains, and rubbish are to be removed or disposed of to the satisfaction of the TA;

(i) Land to be mown shall be accessible to suitable mowing equipment, and is to have an established turf type seed grass cover;

(j) Drainage reserves, ponds, lakes, channels, and streams requiring maintenance shall have suitable access for machinery;

(k) All boundaries are to be surveyed and clearly pegged;

(l) Any rights of way or easements are to be formalised at no cost to the TA;

(m) Any proposed landscape planting or furniture/structures shall be completed.

8 Network utility services

8.1 Scope

This section sets out requirements for the provision of stormwater, wastewater, and water supply systems, power, telecommunications and gas, and their locations in the road. The scope of these provisions applies to both future and existing roads and applies equally to all network utility services.

Note – Network utility services in roads are subject to the Utilities Access Act 2010 and the Infrastructure (Amendments Relating to Utilities Access) Act 2010.

8.2 General

8.2.1 Legislation

Referenced legislation and documents are listed in the Referenced Documents section of this Code of Practice.

8.2.2 Definitions

For the purpose of section 8 the following definitions shall apply:

Code	Means the national code of practice approved in accordance with the Utilities Access Act 2010
Corridor manager	Has the same meaning given to it by the Utilities Access Act 2010

8.2.3 Context

The developer is required to make all arrangements with the appropriate network utility operators for the supply and installation of stormwater, wastewater, water supply, and electric power and to the extent applicable for the provision of telecommunication and gas reticulation.

The developer shall provide satisfactory evidence to the TA corridor manager that the network utility operators are prepared to reticulate the subdivision and that agreement on the financial arrangements for the installation of each supply has been reached. The following applies to each utility:

(a) Stormwater, wastewater, and water supply. Where water supply and wastewater pipes, and stormwater systems are in the road reserve, they shall be installed at the time of road construction to the requirements of the TA corridor manager and the water supply authority for water pipes, or the TA for wastewater pipes and stormwater systems;

(b) Electric power. The supply of electric power will generally be by means of an underground system. Ducts shall be installed at the time of road construction to the requirements of the electrical supply authority and the TA corridor manager. Where the developer is intending to provide electric power other than by underground system, the developer shall provide alternative supply arrangements for approval of the TA;

(c) Telecommunications. Arrangements shall be made with the telecommunication supplier for the reticulation of telecommunication facilities. Where only part of this reticulation is being supplied initially the arrangements shall include the requisite space being maintained for the installation of the remainder of the reticulation at a later date. Ducts will be supplied to the subdividing developer at the time of road construction for installation in the carriageway formation to the requirements of the telecommunications supplier and the TA corridor manager;

(d) Gas. Where an existing gas supply is available or likely to be available to serve a subdivision, the developer may make appropriate arrangements with the gas supply authority and the TA corridor manager, and at the time of road construction, install such ducts/pipes as may be required.

The developer shall follow the requirements of the Code to the extent that they apply to the utility installation for the development.

8.3 Design

8.3.1 Plans

Copies of the plans of the development/subdivision shall be forwarded by the developer to all of the affected network utility operators at an early date to facilitate the design of the reticulation.

> ***C8.3.1***
>
> *It is important that all of the affected network utility operators are advised by the developer of any amendments to the development plan. Information when available on the type of dwellings and likelihood of more than one dwelling on any lot, will be valuable for design purposes.*

8.3.1.1

In preparing the engineering plans consideration shall be given to the requirements of the network utility operators and the TA corridor manager for:

(a) Minimum cover to cables and pipes;

(b) The network utility operator’s desired position for the cable and piping within the road berm as agreed with the TA corridor manager;

(c) The minimum separation distances between power or telecommunication cables, and gas or water mains;

(d) The width of berm which shall be clear of other services and obstructions to enable efficient cable-laying operations.

> ***C8.3.1.1***
>
> *Reference should be made to each network utility operator and the TA corridor manager for their specific requirements. Refer to the Code for further information.*

8.3.2 Utilities above ground

Utilities should preferably be sited within the road berm or on land which will legally become part of the road but which is set back outside the normal road line. Alternatively separate lots (public utility reserves) or easements over private property may be used. If there are any concerns raised about the safety of above ground structures, the risk should be assessed in accordance with the requirements of the Code and any significant risks mitigated.

8.4 Construction

8.4.1 Underground cabling

Underground cable laying shall be achieved by the most appropriate method considering the nature of subsoil and potential damage to infrastructures and shall be to the approval of the TA corridor manager.

> ***C8.4.1***
>
> *The trenchless method is preferred in existing urban areas for underground cabling. Refer to the Code for further information.*

8.4.2 Materials

Materials and sizes of ducts and pipes shall comply with the requirements of the network utility operators and the colours should be in accordance with the Department of Labour's *Guide for safety with underground services.*

8.4.3 Conversion to underground on existing roads

Where a proposed subdivision 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 shall first be agreed between the network utility operator and the TA.

8.4.4 Commercial and industrial subdivisions

The servicing requirements for commercial and industrial areas are often indeterminate. Close liaison between the developer and the network utility operator 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.

8.4.5 Location of services

8.4.5.1 Position in the road

Position and depth shall be agreed with the appropriate network utility operator and the TA corridor manager in accordance with the provisions of the Code.

8.4.5.2 Recording of underground services

TAs shall maintain a procedure for recording the location of their underground services on plans which are readily available to the public at the TA office. It is unlikely that the TA will be able to provide a service for utility services other than those for which it is immediately responsible. These will usually be stormwater, wastewater, and water supply. Other authorities or network utility operators are required to maintain similar records of the existence and detailed location of their services for ready reference.

8.4.5.3 Accuracy and tolerance

It is essential that all services be laid to predictable lines if there is to be a reasonable opportunity of laying new services in existing systems. In addition to specifying the location of any service in the road berm, there should also be a tolerance which shall on no account be exceeded without proper measurement and recording on the detailed record plan. Tolerance of ±300 mm in the horizontal and ±100 mm in the vertical is a practicable requirement.

8.4.6 Trenches

8.4.6.1

When new subdivision construction is undertaken the backfilling and compaction of trenches to a state of stability consistent with the future of the surface shall be carried out in accordance with the Code and to the satisfaction of the TA corridor manager.

8.4.6.2

Where underground services are laid after the initial construction of the subdivision or where they are extended from an existing area into a new one, special attention shall be given to the opening and reinstatement of trenches in accordance with the Code and to the satisfaction of the TA corridor manager.

> ***C8.4.6***
>
> *TAs are recommended to prepare standard specifications for the opening of trenches and the restoration of surfaces. Network utility operators are in turn recommended to comply with the requirements of such specifications.*
>
> *Refer to the Code for further guidance.*

8.4.7 Completion of Work

Following completion of the works and prior to issuing a 224(c) certificate the developer shall provide written confirmation from the Network Utility Service providers that the installation has been completed to their standards and that they are satisfied with access provisions allowing for maintenance and future upgrading of their network.

Appendix A – Acceptable pipe and fitting materials

(Informative)

Table A1 and table A2 give information on acceptable pipe and fitting materials. The information is sourced with permission from the Water Services Association of Australia. Refer also to WSA 02 (Sewerage Code of Australia) and WSA 03 (Water Supply Code of Australia) for further information.

Table A1 – Acceptable pipe materials and Standards

NOTE – Refer also to WSA 02 (Sewerage Code of Australia) and WSA 03 (Water Supply Code of Australia)

Pipe materials	Standard applicable	Stormwater (Gravity)	Wastewater (Pressure sewer/ rising main)	Wastewater (Gravity)	Water supply (Pressure)	Notes
PVC-U	AS/NZS 1260 (Class SN 4, 8, or 16 as required by TA)	✓	–	✓	–	Gravity applications only. Well established methods of repair. Suitable for aggressive groundwater, anaerobic conditions and tidal zones. Can be used for trenchless installation with suitable end load resistant joints.
PVC-U	AS/NZS 1254 (Class SN 4, or 8, as required by TA)	✓	–	–	–	Gravity stormwater applications only.
PVC-O	AS/NZS 4441 (Series 1 or Series 2, as required by the TA)	–	✓	–	✓	Improved fracture toughness compared with PVC-U. Improved fatigue resistance compared with PVC-U and PVC-M. NOTE – Use only DI fittings in pumped mains to achieve full fatigue resistance. Has increased hydraulic capacity compared with PVC-U and PVC-M. Suitable for aggressive groundwater, anaerobic conditions, and tidal zones. Specific design for dynamic stresses (fatigue) required for pressure sewer applications.
PVC-U	AS/NZS 1477 (Series 1 or Series 2, as required by the TA)	–	✓	–	✓	Well established methods of repair. Alternative installation techniques possible, for example slip lining. Suitable for aggressive groundwater, anaerobic conditions, and tidal zones. Can be used for trenchless installation with suitable end load resistant joints. Specific design for dynamic stresses (fatigue) required for pressure sewer applications.

Pipe materials	Standard applicable	Stormwater (Gravity)	Wastewater (Pressure sewer/ rising main)	Wastewater (Gravity)	Water supply (Pressure)	Notes

Table A1 – Acceptable pipe materials and Standards (continued)

Pipe materials	Standard applicable	Stormwater (Gravity)	Wastewater (Pressure sewer/ rising main)	Wastewater (Gravity)	Water supply (Pressure)	Notes
PVC-M	AS/NZS 4765 (Series 1 or Series 2, as required by the TA)	–	✓	–	✓	Improved fracture toughness compared with PVC-U. Has increased hydraulic capacity compared with PVC-U. Inferior fatigue resistance compared with PVC-U and PVC-O. Suitable for aggressive groundwater, anaerobic conditions and tidal zones. Specific design for dynamic stresses (fatigue) required for pressure sewer applications.
PE (PE 80B or PE 100 as required by the TA)	AS/NZS 4130	–	✓	–	✓	Generally for pressure applications. Can be easily curved to eliminate the need for bends. Alternative installation techniques possible, for example pipe cracking, direction drilling, and slip lining. Can be welded to form an end load resistant system. Compression couplings and end load resistant fittings are available in smaller diameters. Pipe longitudinal flexibility accommodates large differential ground settlement. Fusion jointing requires skilled installers and special equipment. Retrospective installation of fittings/repair complicated. Specific design for dynamic stresses (fatigue) required for pressure sewer applications. ≤ DN 125 available in long coiled lengths for fewer joints. Suitable for aggressive groundwater, anaerobic conditions or tidal zones. Suitable for ground with high subsidence potential, for example fill or mining areas.

Table A1 – Acceptable pipe materials and Standards (continued)

Pipe materials	Standard applicable	Stormwater (Gravity)	Wastewater (Pressure sewer/ rising main)	Wastewater (Gravity)	Water supply (Pressure)	Notes
PE (Stiffness Class SN 4, 8, 10, or 16 as required by the TA)	AS/NZS 5065	✓	–	✓	–	Only for gravity applications. Can be easily curved. Alternative installation techniques possible, for example pipe cracking and slip lining. Can be welded to form an end load resistant system. Fusion jointing requires skilled installers and special equipment. Retrospective installation of fittings/repair complicated. Smaller diameters available in long coiled lengths for fewer joints. Suitable for aggressive groundwater, anaerobic conditions, or tidal zones.
PP (Stiffness Class SN 4, 8, 10, or 16 as required by the TA)	AS/NZS 5065	✓	–	✓	–	Only for gravity applications.
GRP	AS 3571.1	✓	✓	✓	–	Alternative installation techniques possible, for example slip lining. UV resistant (special product). Custom made fittings can be manufactured. Suitable for use without additional corrosion protection in areas where stray electrical currents occur. Low impact resistance and ease of damage to thermosetting resin, makes GRP susceptible to damage during transportation, and installation, in above ground installations, from vandalism, or when damaged as a consequence of nearby excavation. Suitable for aggressive groundwater, anaerobic conditions or tidal zones.

Table A1 – Acceptable pipe materials and Standards (continued)

Pipe materials	Standard applicable	Stormwater (Gravity)	Wastewater (Pressure sewer/ rising main)	Wastewater (Gravity)	Water supply (Pressure)	Notes
GRP	AS 3571.2	–	–	–	✓	Alternative installation techniques possible, for example slip lining. UV resistant (special product). Custom made fittings can be manufactured. Suitable for use without additional corrosion protection in areas where stray electrical currents occur. Low impact resistance and ease of damage to thermosetting resin, makes GRP susceptible to damage during transportation, and installation, in above ground installations, from vandalism, or when damaged as a consequence of nearby excavation. Suitable for aggressive groundwater, anaerobic conditions, or tidal zones.
VC	BS EN 295	✓	–	✓	–	Gravity applications only. Has benefits for particularly aggressive industrial wastes. Not recommended for active seismic (earthquake) zones, or unstable ground.
RRRC (rubber ring joint reinforced concrete)	AS/NZS 4058	✓	–	✓	–	Requires protection from hydrogen sulphide attack in sewer applications, by plastic lining or selection of appropriate cement additives.

Table A1 – Acceptable pipe materials and Standards (continued)

Pipe materials	Standard applicable	Stormwater (Gravity)	Wastewater (Pressure sewer/ rising main)	Wastewater (Gravity)	Water supply (Pressure)	Notes
CLS (SCL) (concrete lined welded steel)	NZS 4442 AS 1579	–	✓	–	✓	Cement mortar lined, PE coating below ground or heavy duty coating above ground High mechanical strength and toughness. Available in long lengths. RRJ and welded joints available. Custom made, specially configured steel fittings can be made to order. Can be welded to form a system that will resist end load and joint permeation. UV resistant/vandal proof/impact resistant (where PE coated). Cathodic protection (CP) can be applied to electrically continuous pipelines to provide enhanced corrosion protection. PE lined and coated – RRJ As above for CLS (SCL). Suitable for conveying soft water. Corrosion resistant under all conditions. General notes Standard Portland cement mortar not resistant to H^2S attack, at any high points or discharge points in the main. High alumina cement has improved resistance. Welded joints require skilled installers and special equipment. Welded joints require reinstatement of protection systems on site. Special design required for welded installations parallel, and adjacent to high voltage (> 66 kV) transmission lines. Cathodic protection requires regular monitoring and maintenance. Seal coating may be required over cement mortar linings, when conveying soft water, or in low flow extremities of reticulation mains, to prevent potentially high PH. Suitable for high load applications such as railway crossings and major roads. Large diameters are available. Suitable for aerial or suspended pipeline applications.

Table A1 – Acceptable pipe materials and Standards (continued)

Pipe materials	Standard applicable	Stormwater (Gravity)	Wastewater (Pressure sewer/ rising main)	Wastewater (Gravity)	Water supply (Pressure)	Notes
DI (ductile iron pipe)	AS/NZS 2280 AS 3681	–	✓	–	✓	Fatigue analysis not normally required (pressure sewer applications). High mechanical strength and toughness. Ease of jointing. UV resistant/vandal proof/impact resistant. Well established methods of repair. Suitable for high pressure and above ground pipelines. Restrained joint systems available. Sufficient ring stiffness to not rely on side support, for structural adequacy for the usual water supply installation depths. Elevated PH may occur when conveying soft water, or in low flow extremities of reticulation mains. PE sleeving is required, and must be carefully applied and repaired when damaged. Standard Portland cement mortar not resistant to H2S attack, at any high points or discharge points in the main. (Wastewater applications. High alumina cement has improved resistance.) Not suitable for aggressive groundwater, anaerobic conditions, or tidal zones.
Corrugated aluminium pipe	AS/NZS 2041	✓	–	–	–	Generally of short length (for culverts and so on). Joints need consideration in fine soils with high water tables. Invert may need lining to extend life.
Corrugated steel pipe	AS/NZS 2041 NZS 4405 NZS 4406	✓	–	–	–	Generally only for short length (culverts and so on). Joints need consideration in fine soils and high water tables. Invert may need lining to extend life.
ABS	AS/NZS 3518 AS/NZS 3690 AS/NZS 3879	–	✓	–	✓	Specific design for dynamic stresses (fatigue required for pressure sewer applications).
PVC-U	AS/NZS 1260		–		–	Gravity applications only.

Pipe materials	Standard applicable	Stormwater (Gravity)	Wastewater (Pressure sewer/ rising main)	Wastewater (Gravity)	Water supply (Pressure)	Notes
PVC-U	AS/NZS 1254		–	–	–	Gravity stormwater applications only.

Table A2 – Acceptable fitting materials and Standards

Fittings Materials	Standard applicable	Stormwater (Gravity)	Wastewater (Pressure sewer/ rising main	Wastewater (Gravity)	Water supply (Pressure)	Notes
PVC-U	AS/NZS 1254	✓	–	–	–	Gravity stormwater applications only.
PE	AS/NZS 4129	✓	✓	✓	✓	PE pressure fittings, including mechanical compression, butt fusion or electrofusion, as approved by the TA.
Access covers and grates	AS 3996	✓	–	✓	–	
Ductile iron	AS/NZS 2280	–	✓	–	✓	Generally for pressure applications. Shall be coated with a polymeric coating, applied in accordance with AS/NZS 4158.
Ductile iron unrestrained mechanical couplings	AS/NZS 4998	–	✓	–	✓	Generally for pressure applications. Shall be coated with a polymeric coating, applied in accordance with AS/NZS 4158.
Plastic or metallic tapping bands	AS/NZS 4793	–	✓	–	✓	Generally for pressure applications. Tapping bands used on flexible pipes shall be AS/NZS 4793 Type F – that is, 'full circle design'. Ductile iron tapping bands shall be coated with a polymeric coating, applied in accordance with AS/NZS 4158.
Fire hydrants	NZS/BS 750	–	✓	–	✓	Generally pressure applications.
Resilient seated gate valves	AS 2638.2	–	✓	–	✓	Generally pressure applications.
PE (Stiffness Class SN 4, 8, 10 or 16 as required by the TA)	AS/NZS 5065	✓	–	✓	–	Gravity applications only.
PP (Stiffness Class SN 4, 8, 10	AS/NZS 5065	✓	–	✓	–	Gravity applications only.

or 16 as required by the TA)						

Appendix B – Standard construction drawings

(Informative)

The following drawings are sourced with permission from the Water Services Association of Australia and modified for New Zealand conditions.

COMMON DETAILS

CM – 001	Embedment and trenchfill – Typical arrangement
CM – 002	Standard embedment – Flexible and rigid pipes
CM – 003	Bulkheads and trenchstop – Standard details
CM – 004	Manhole – Standard details
CM – 005	Manholes – Mini and drop manhole details
CM – 006	Manholes – Stormwater or wastewater DN 375 to DN 750

WATER SUPPLY

WS – 001	Typical mains construction – Reticulation main arrangements
WS – 002	Typical mains construction – Distribution and transfer mains
WS – 003	Property services – Connection to main
WS – 004	Thrust blocks – Concrete block details
WS – 005	Thrust and anchor blocks – Gate valves and vertical bends
WS – 006	Valve and hydrant identification – Identification markers and marker posts

WASTE WATER

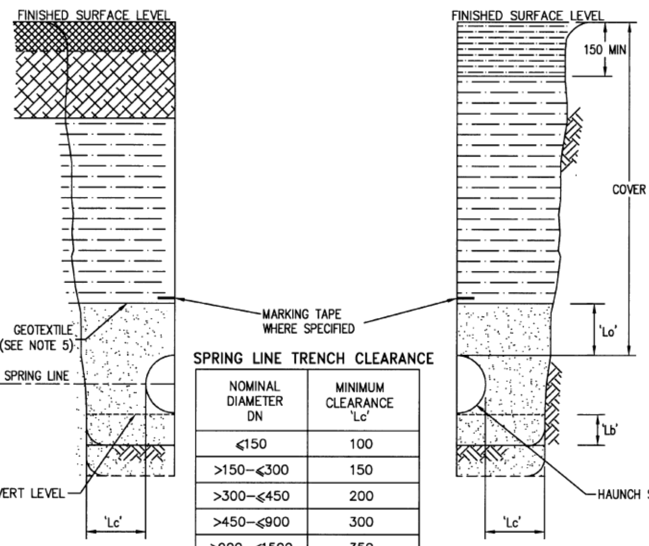
WW – 001	Pipelaying – Typical arrangements
WW – 002	Property connections – Buried interface method
WW – 003	Maintenance shafts – Typical installation
WW – 004	Maintenance shafts – MS and variable bend installations
WW – 005	Maintenance shafts – TMS and connection installations
WW – 006	Maintenance shafts – Typical MS cover arrangements

These drawings will be available in standard CAD and .pdf formats as free downloads from the Standards New Zealand webshop (www.standards.co.nz). Purchasers of NZS 4404:2010 will be able to adapt the CAD drawings for incorporation into their specific design without breaching copyright.

All dimensions are in millimetres unless otherwise stated.

MATERIAL		ZONE	
ROAD SURFACE	NON ROAD SURFACES		
ROAD SURFACE LAYER	TO MATCH EXISTING	SURFACE COURSE	
TO MATCH EXISTING ROAD BASE OR TO TERRITORIAL AUTHORITY REQUIREMENTS		ROAD BASE	
TRENCH FILL MATERIALS TO BE SIMILAR WITH SNZ HB 2002 APPENDIX L OR TO TERRITORIAL AUTHORITY REQUIREMENTS OR INORGANIC FILL MATERIAL WITH 75 MAXIMUM STONE SIZE	TRENCH FILL MATERIALS TO BE SIMILAR WITH SNZ HB 2002 APPENDIX L OR TO TERRITORIAL AUTHORITY REQUIREMENTS OR INORGANIC FILL MATERIAL WITH 75 MAXIMUM STONE SIZE	TRENCH FILL (AS SPECIFIED IN DESIGN DRAWINGS)	
EMBEDMENT MATERIAL IN ACCORDANCE WITH DESIGN DRAWINGS AND TERRITORIAL AUTHORITY (SEE NOTE 4)		OVERLAY	EMBEDMENT
		SIDE SUPPORT	EMBEDMENT
BEDDING MAY BE OMITTED IF TRENCH BASE IS GRANULAR SAND OR GRAVEL OF SUITABLE GRADING.		BEDDING	EMBEDMENT
		OVER–EXCAVATION	

VEHICULAR LOADING



SPRING LINE TRENCH CLEARANCE

NOMINAL DIAMETER DN	MINIMUM CLEARANCE 'Lc'
⩽150	100
>150–⩽300	150
>300–⩽450	200
>450–⩽900	300
>900–⩽1500	350

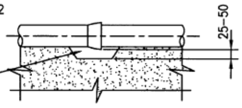
TRENCH WIDTH TO BE SUFFICIENT TO SAFELY LAY PIPE AND COMPACT THE SIDE SUPPORT ZONE.

ZONE		MATERIAL
TOPSOIL OR PAVEMENT		ORIGINAL OR IMPORTED MATERIAL TO MATCH EXISTING
TRENCH FILL		INORGANIC FILL MATERIAL WITH 75 MAXIMUM STONE SIZE
EMBEDMENT	OVERLAY	EMBEDMENT MATERIAL IN ACCORDANCE WITH DESIGN DRAWINGS AND TERRITORIAL AUTHORITY (SEE NOTE 4)
EMBEDMENT	SIDE SUPPORT	
EMBEDMENT	BEDDING	BEDDING MAY BE OMITTED IF TRENCH BASE IS GRANULAR SAND OR GRAVEL OF SUITABLE GRADING
OVER–EXCAVATION		

NO VEHICULAR LOADING

INCLUDES LOCATIONS WHERE OCCASIONAL VEHICLE LOADING OCCURS SUCH AS RESERVES AND FOOTWAYS

'Lo' – 100 mm MIN. NON TRAFFICABLE
– 300 mm MIN. TRAFFICABLE
'Lb' – REFER TO CM – 002



PROVIDE POCKETS IN BEDDING, AT JOINTS PRIOR TO LAYING PIPES. FILL VOID DURING COMPLETION OF EMBEDMENT.

PIPE JOINT BEDDING POCKETS

FOR JOINT PROJECTIONS (SOCKETS, FLANGES AND SO ON)

NOTE –

1. ALL DIMENSIONS IN MILLIMETRES.
2. SPECIFY SPECIAL BEDDING TO SUIT THE CONDITIONS IF THE TRENCH FLOOR HAS:
   – IRREGULAR OUTCROPS OF ROCK OR
   – BEEN DISTURBED BY UNCONTROLLED GROUND WATER.
3. COMPACT AND EVENLY GRADE FINISHED TRENCH FLOOR.
4. EMBEDMENT, TRENCH FILL AND COMPACTION TO MEET THE REQUIREMENT OF DESIGN DRAWINGS OR SPECIFICATIONS.
5. USE GEOTEXTILE FILTER FABRIC WHERE SPECIFIED.
6. SIDES OF EXCAVATION TO BE KEPT VERTICAL TO AT LEAST 150 ABOVE THE PIPE.

STANDARDS NEW ZEALAND PAEREWA AOTEAROA
ORIGINAL SOURCE DRAWINGS: WATER SERVICES ASSOCIATION OF AUSTRALIA

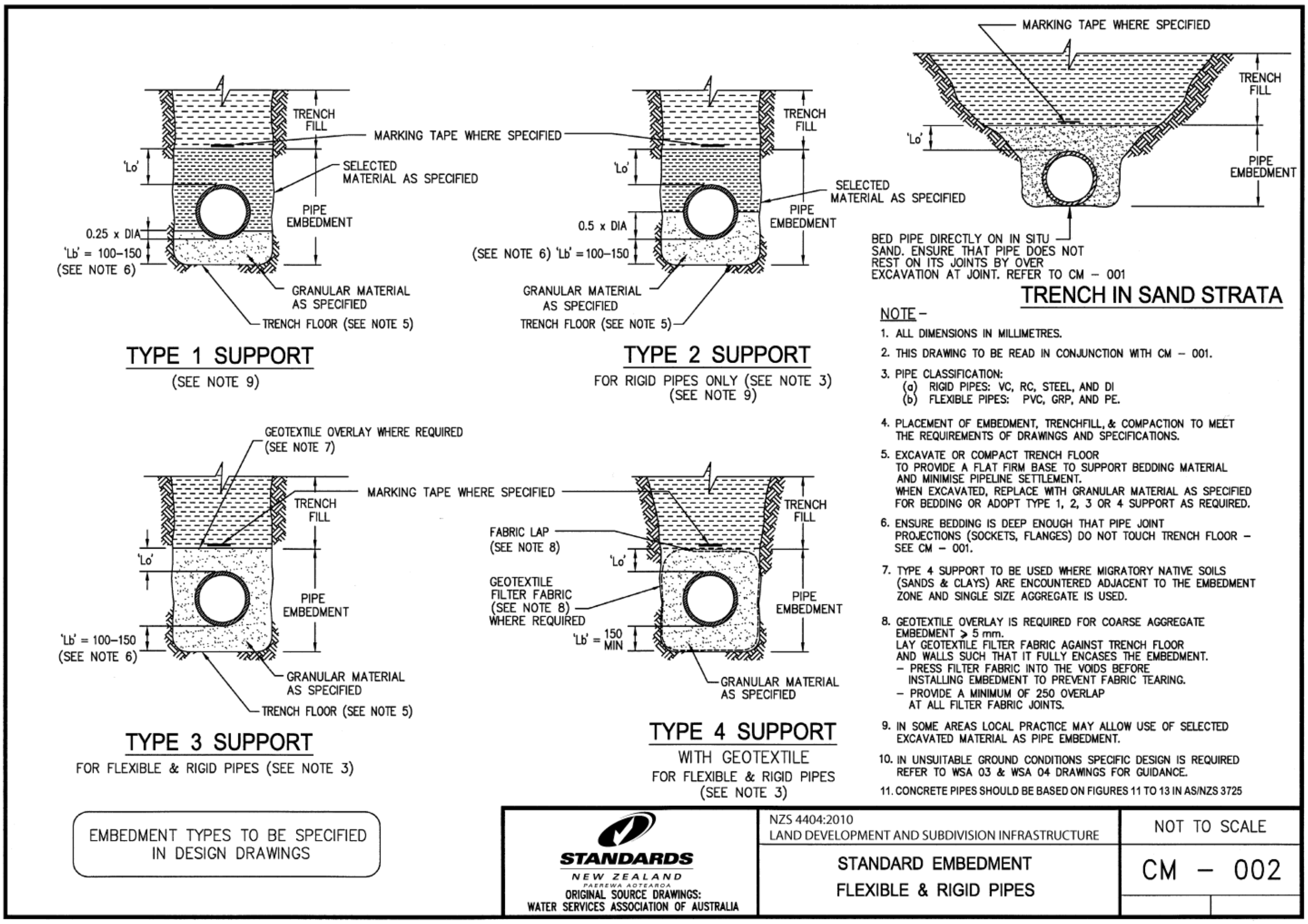
NZS 4404:2010
LAND DEVELOPMENT AND SUBDIVISION INFRASTRUCTURE

EMBEDMENT & TRENCHFILL TYPICAL ARRANGEMENT

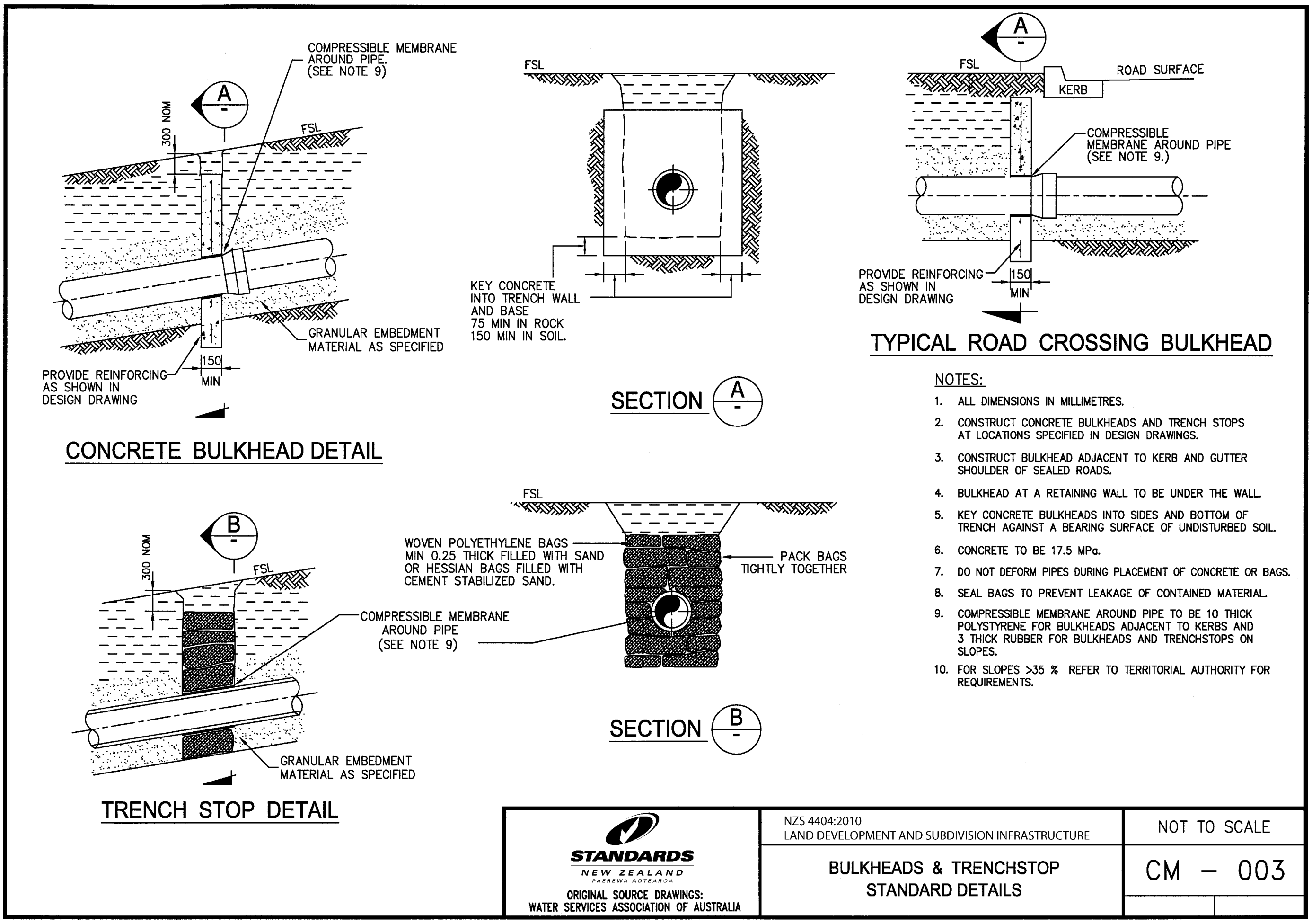
NOT TO SCALE

CM – 001

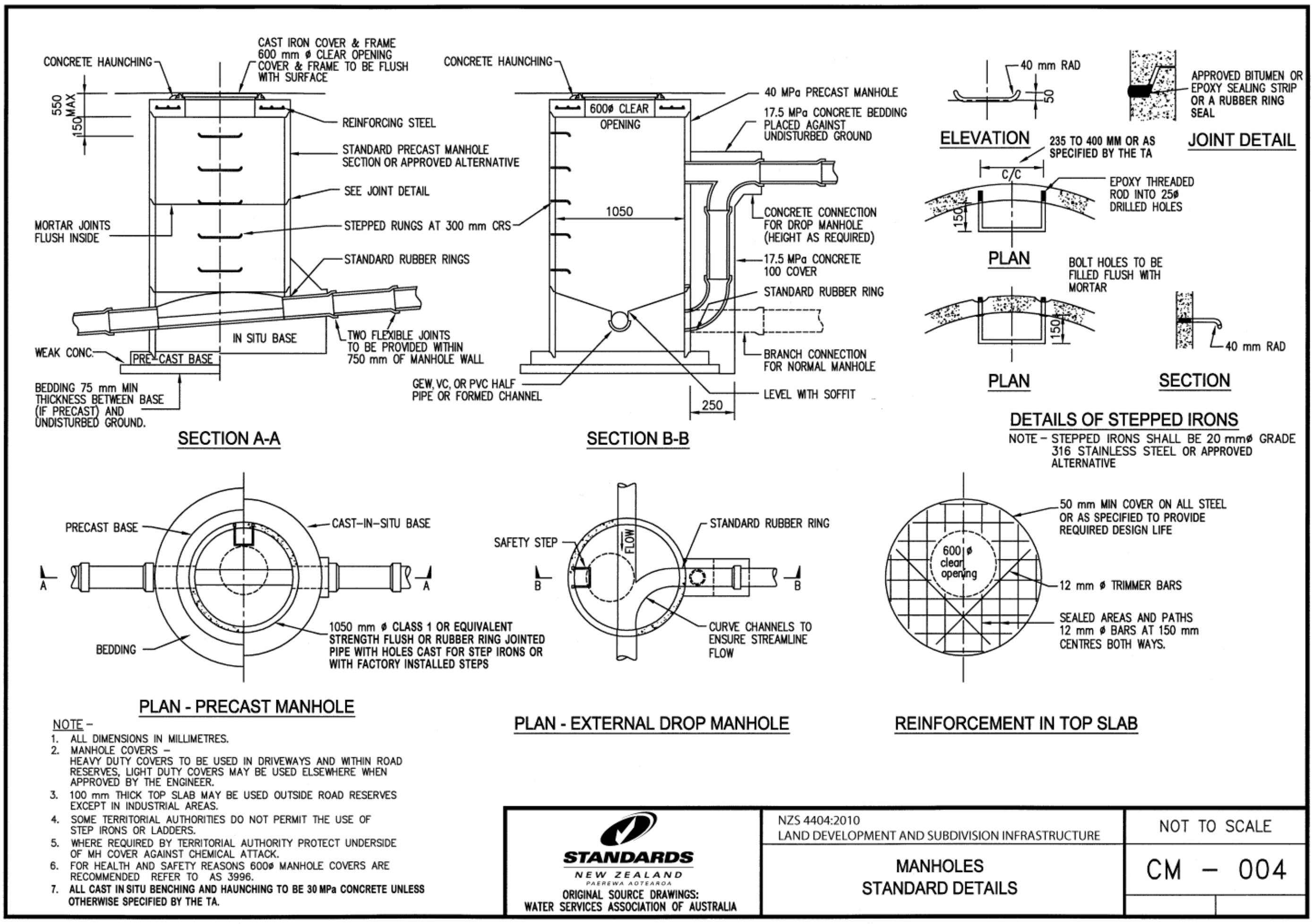
CM – 001 Embedment and trenchfill – Typical arrangement



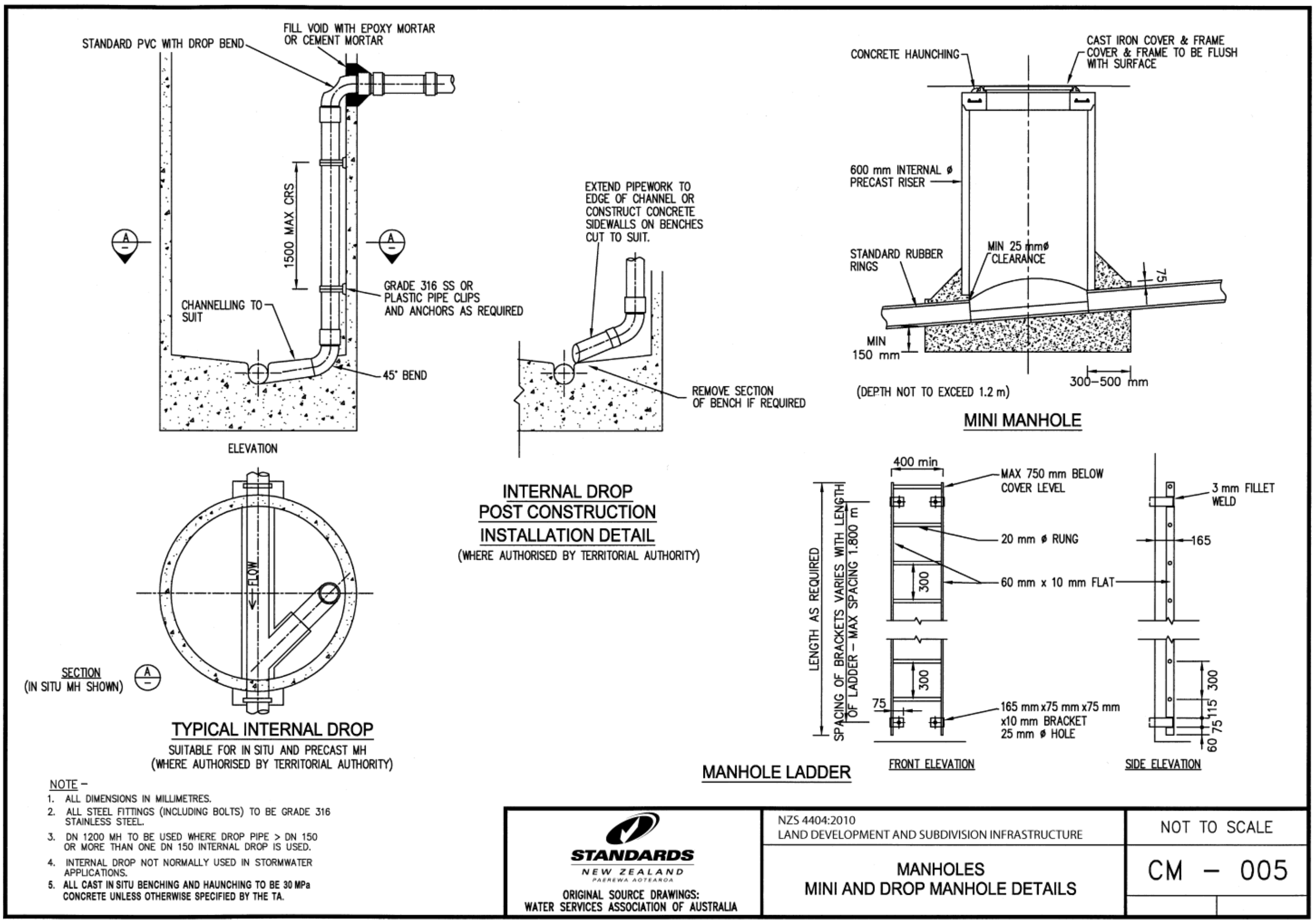
CM – 002 Standard embedment – Flexible and rigid pipes



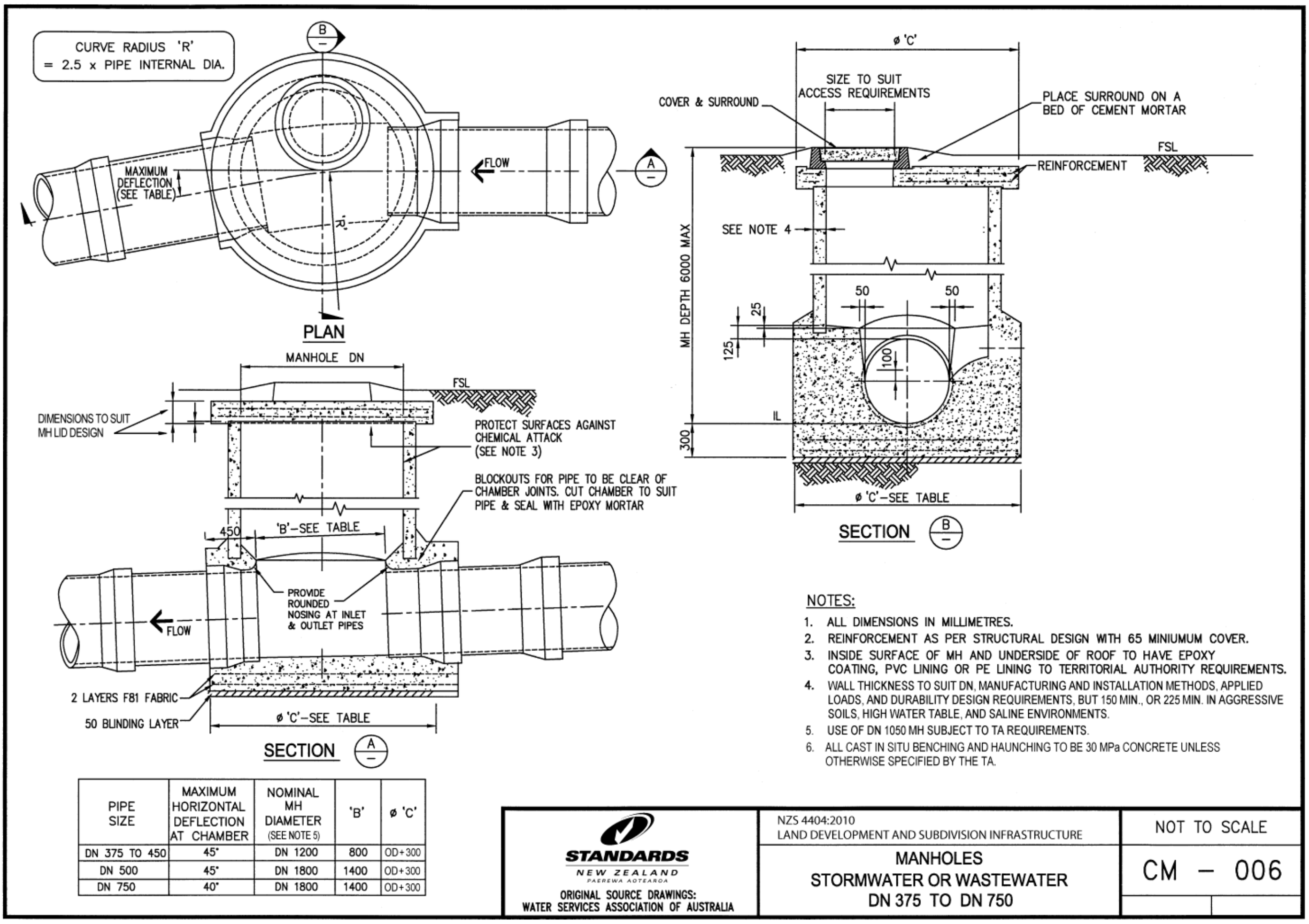
CM – 003 Bulkheads and trenchstop – Standard details



CM – 004 Manhole – Standard details

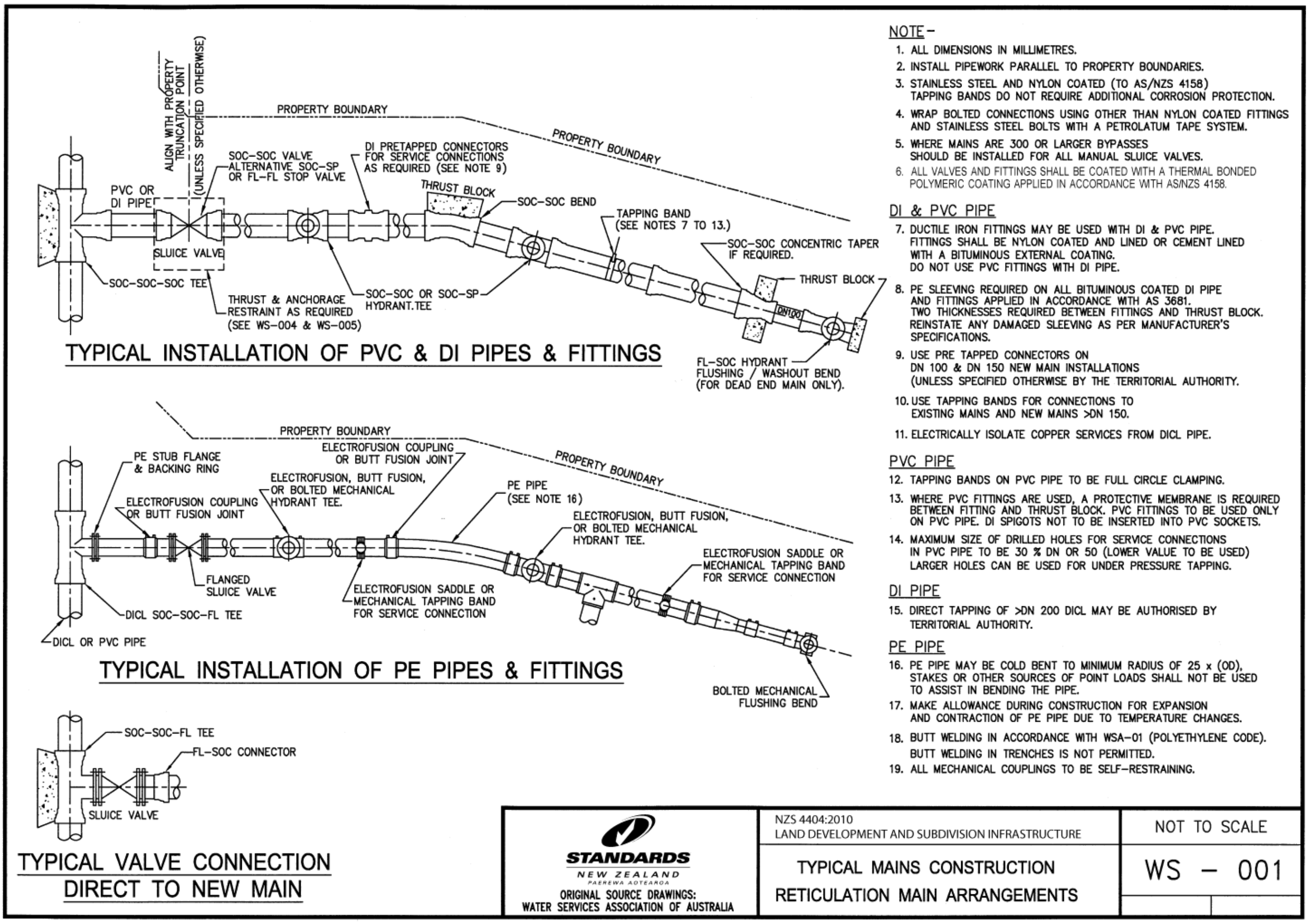


CM – 005 Manholes – Mini and drop manhole details

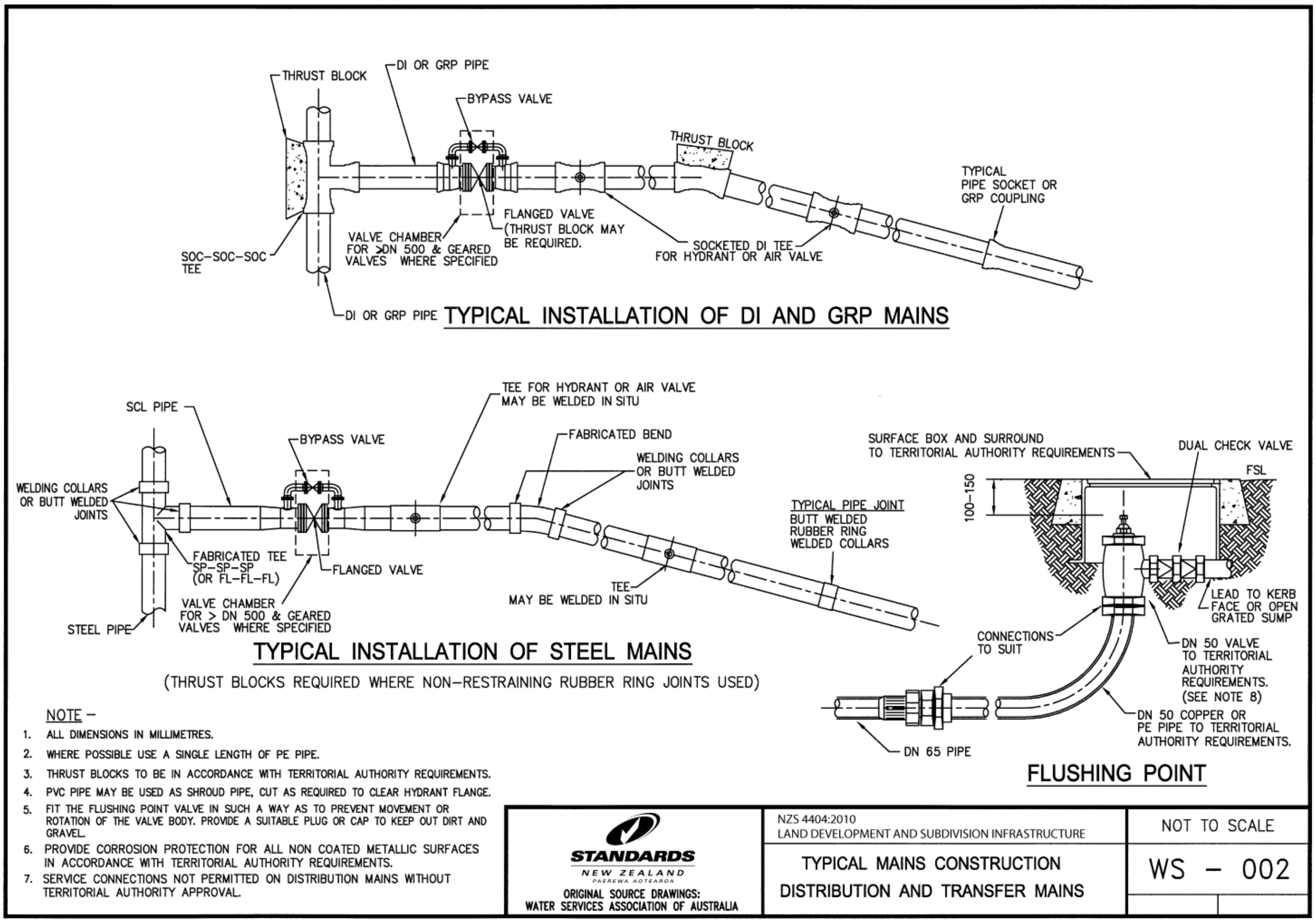


PIPE SIZE	MAXIMUM HORIZONTAL DEFLECTION AT CHAMBER	NOMINAL MH DIAMETER (SEE NOTE 5)	'B'	ø 'C'
DN 375 TO 450	45°	DN 1200	800	OD+300
DN 500	45°	DN 1800	1400	OD+300
DN 750	40°	DN 1800	1400	OD+300

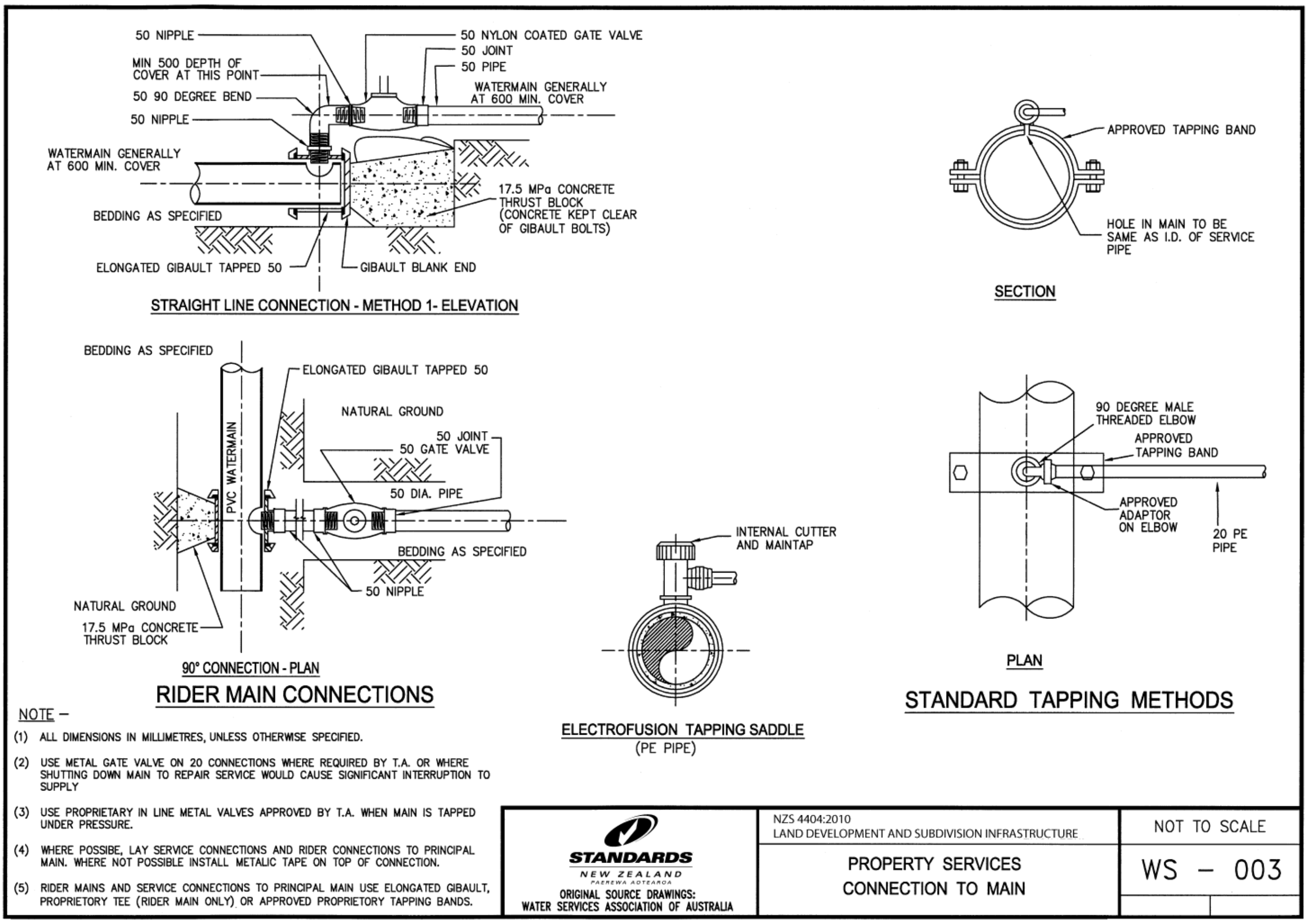
CM – 006 Manholes – Stormwater or wastewater DN 375 to DN 750



WS – 001 Typical mains construction – Reticulation main arrangements



WS – 002 Typical mains construction – Distribution and transfer mains

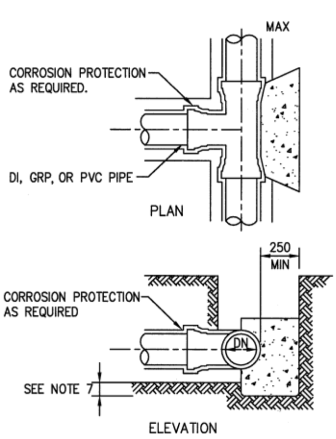


WS – 003 Property services – Connection to main

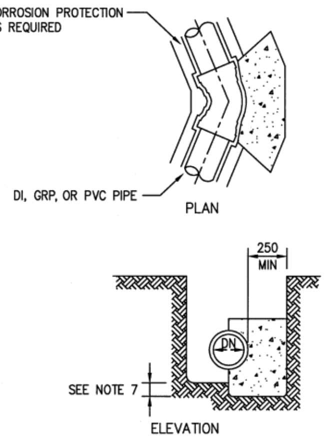
MINIMUM THRUST AREA FOR BLOCKS IN SQUARE METRES (m^2)
DESIGN PRESSURE 1000 kPa (NOM. 100 m HEAD)

SOIL CLASSIFICATION AND ALLOWABLE HORIZONTAL BEARING PRESSURE OF GROUND. (SEE NOTE 3)	90° & 60° HORIZONTAL BENDS			45° & 30° HORIZONTAL BENDS			22.5° HORIZONTAL BENDS			11.25° HORIZONTAL BENDS			TEES AND DEAD ENDS		
FOR HORIZONTAL THRUST ON TRENCH WALLS WHERE THE COVER OVER PIPES IS 450 OR GREATER	STIFF CLAY MEDIUM DENSE CLEAN SAND	VERY STIFF CLAY DENSE SAND/GRAVEL DECOMPOSED ROCK	HARD CLAY SOUND ROCK	STIFF CLAY MEDIUM–DENSE CLEAN SAND	VERY STIFF CLAY DENSE SAND/GRAVEL DECOMPOSED ROCK	HARD CLAY SOUND ROCK	STIFF CLAY MEDIUM–DENSE CLEAN SAND	VERY STIFF CLAY DENSE SAND/GRAVEL DECOMPOSED ROCK	HARD CLAY SOUND ROCK	STIFF CLAY MEDIUM–DENSE CLEAN SAND	VERY STIFF CLAY DENSE SAND/GRAVEL DECOMPOSED ROCK	HARD CLAY SOUND ROCK	STIFF CLAY MEDIUM–DENSE CLEAN SAND	VERY STIFF CLAY DENSE SAND/GRAVEL DECOMPOSED ROCK	HARD CLAY SOUND ROCK
PBH kPa	50	100	200	50	100	200	50	100	200	50	100	200	50	100	200
NOMINAL DIAMETER OF FITTING (DN)															
100	0.34	0.17	N	0.18	N	N	N	N	N	N	N	N	0.24	0.12	N
150	0.70	0.35	0.18	0.38	0.19	N	0.20	N	N	N	N	N	0.50	0.25	0.12
200	1.20	0.60	0.30	0.64	0.32	0.16	0.34	0.17	N	0.16	N	N	0.84	0.42	0.21
225	1.52	0.75	0.38	0.81	0.41	0.21	0.42	0.22	0.11	0.22	N	N	1.06	0.53	0.27
250	1.80	0.91	0.45	0.98	0.49	0.25	0.50	0.25	0.12	0.26	0.13	N	1.28	0.64	0.32
300	2.66	1.33	0.66	1.44	0.72	0.36	0.74	0.37	0.18	0.36	0.18	N	1.88	0.94	0.47
375	4.04	2.02	1.01	2.18	1.09	0.55	1.12	0.56	0.28	0.56	0.28	0.14	2.86	1.43	0.72
225	5.71	2.86	0.73	3.09	1.55	0.40	1.58	0.79	0.20	1.58	0.79	0.20	4.04	2.02	0.52
250	6.98	3.49	0.89	3.78	1.89	0.49	1.93	0.98	0.25	1.93	0.98	0.25	4.93	2.37	0.63
300	9.89	4.95	1.27	5.36	2.68	0.68	2.73	1.36	0.35	2.73	1.36	0.35	6.90	3.50	0.89
375	15.16	7.58	1.94	8.21	4.10	1.05	4.19	2.10	0.53	4.19	2.10	0.53	10.72	5.36	1.37

'N' DENOTES NOMINAL THRUST AREA – (SEE NOTES 4 & 5)
PBH – ALLOWABLE HORIZONTAL BEARING PRESSURE

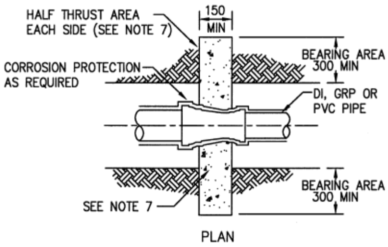


THRUST BLOCK FOR TEES
(FOR HORIZONTAL THRUST)



THRUST BLOCK FOR BENDS
(FOR HORIZONTAL THRUST)

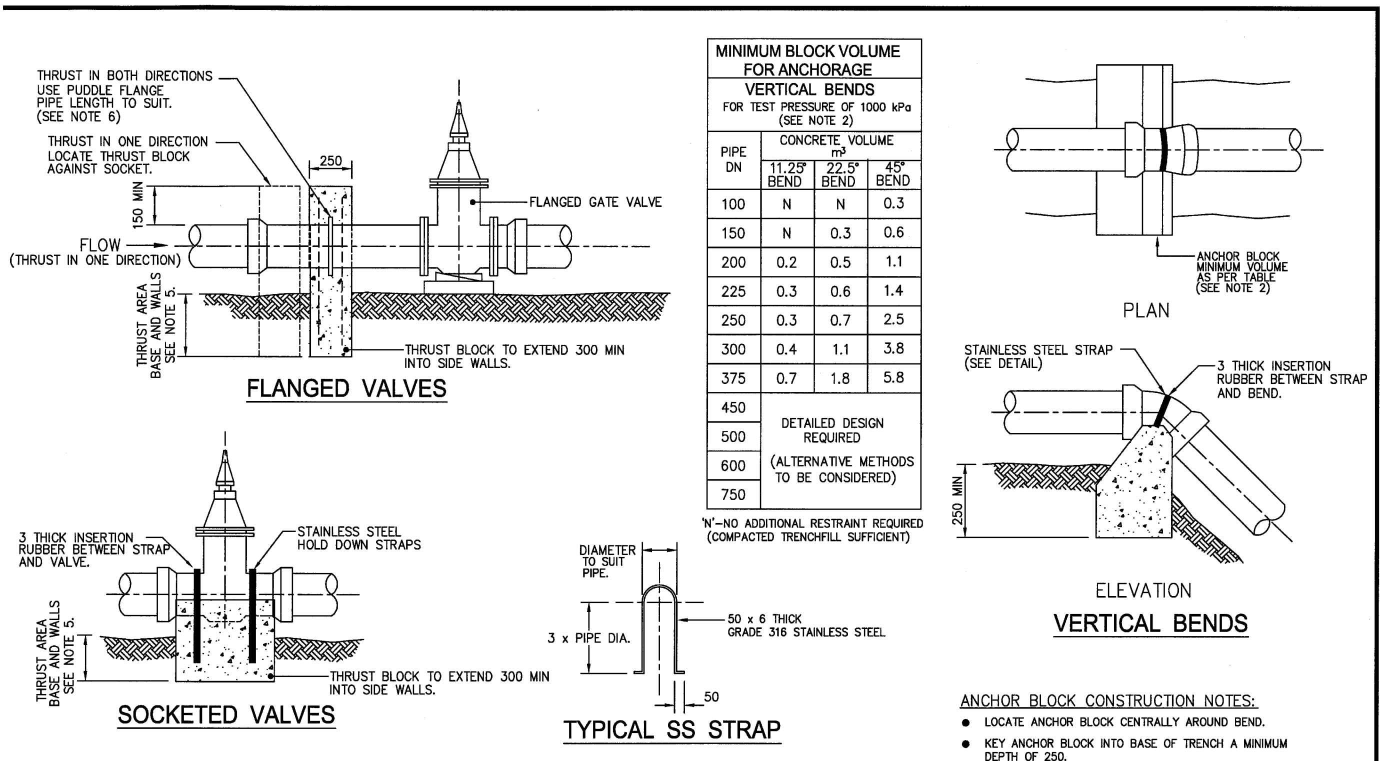
NOTE –
1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.
2. CAST THE THRUST AREA OF ALL THRUST BLOCKS AGAINST A CLEAN FACE OF UNDISTURBED NATURAL SOIL. THRUST BLOCKS NOT TO INTERFERE WITH OTHER SERVICES.
3. DO NOT USE STANDARD THRUST BLOCKS AS SPECIFIED IN THIS DRAWING IN:
   – VERY SOFT, SOFT, OR FIRM CLAY.
   – LOOSE CLEAN SAND.
   – UNCOMPACTED FILL OR REFUSE.
   A GEOTECHNICAL ASSESSMENT AND INDIVIDUAL DESIGN IS REQUIRED FOR THESE SOILS.
4. THE NOMINAL THRUST AREA 'N' TO BE ACHIEVED BY POURING CONCRETE THE FULL LENGTH OF THE FITTING AND TO A DEPTH THAT ENSURES THE THRUST IS VERTICALLY AND HORIZONTALLY CENTRED ON THE RESULTING THRUST BLOCK (ALSO SEE NOTE 7).
5. DESIGN PRESSURES OTHER THAN 1000 kPa REDUCE OR INCREASE THE MINIMUM THRUST AREA BY THE RATIO OF THE DESIGN PRESSURES EXCEPT WHERE:
   – MIN THRUST AREA IS <0.1 m^2, AND
   – 'N' APPEARS IN THE TABLE AND DESIGN PRESSURE IS ABOVE 1000 kPa. CALCULATE THE AREA.
6. FINISH THRUST BLOCKS APPROXIMATELY 100 ABOVE THE TOP OF THE FITTING OR BEARING PAD AND EXTEND TO THE FLOOR OF THE TRENCH OR DEEPER IF NECESSARY TO ACHIEVE THE REQUIRED THRUST AREA. MAXIMUM ENCASEMENT TO BE 180°
7. THE MINIMUM THRUST AREA FOR TAPER THRUST BLOCKS TO BE EQUAL TO THE DIFFERENCE BETWEEN THE THRUST AREAS FOR DEAD ENDS OF EQUIVALENT DIAMETER TO THOSE EACH SIDE OF TAPER.
8. FOR DOWNWARD VERTICAL THRUST, THE ALLOWABLE BEARING PRESSURES FOR VARIOUS SOILS MAY BE TAKEN AS TWICE THAT FOR HORIZONTAL THRUST SHOWN.
9. WHEN POURING CONCRETE AGAINST FITTINGS PLACE A MEMBRANE OF POLYETHYLENE, PVC OR FELT BETWEEN THE FITTING AND CONCRETE TO PREVENT DAMAGE TO THE FITTING. JOINTS TO BE CLEAR OF CONCRETE.
10. CONCRETE TO BE KEPT CLEAR OF BOLTS & FLANGES OR GIBAULT JOINTS TO ALLOW FITTINGS TO BE REMOVED WITHOUT INTERFERING WITH ANCHOR BLOCK.



TAPER THRUST BLOCK
(FOR HORIZONTAL THRUST)

STANDARDS NEW ZEALAND PAEREWA AOTEAROA ORIGINAL SOURCE DRAWINGS: WATER SERVICES ASSOCIATION OF AUSTRALIA	NZS 4404:2010 LAND DEVELOPMENT AND SUBDIVISION INFRASTRUCTURE	NOT TO SCALE	
	THRUST BLOCKS CONCRETE BLOCK DETAILS	WS – 004	

WS – 004 Thrust blocks – Concrete block details



MINIMUM BLOCK VOLUME FOR ANCHORAGE
VERTICAL BENDS
FOR TEST PRESSURE OF 1000 kPa (SEE NOTE 2)

PIPE DN	CONCRETE VOLUME m^3		
	11.25° BEND	22.5° BEND	45° BEND
100	N	N	0.3
150	N	0.3	0.6
200	0.2	0.5	1.1
225	0.3	0.6	1.4
250	0.3	0.7	2.5
300	0.4	1.1	3.8
375	0.7	1.8	5.8
450	DETAILED DESIGN REQUIRED (ALTERNATIVE METHODS TO BE CONSIDERED)		
500			
600			
750			

'N'–NO ADDITIONAL RESTRAINT REQUIRED (COMPACTED TRENCHFILL SUFFICIENT)

ANCHOR BLOCK CONSTRUCTION NOTES:

- LOCATE ANCHOR BLOCK CENTRALLY AROUND BEND.
- KEY ANCHOR BLOCK INTO BASE OF TRENCH A MINIMUM DEPTH OF 250.
- POUR CONCRETE AGAINST A SOLID EXCAVATION FACE.
- USE GRADE 17.5 MPa CONCRETE.
- KEEP CONCRETE CLEAR OF ALL BOLTS, NUTS, AND PIPE JOINTS.

NOTE –

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE SHOWN.
2. ANCHOR BLOCKS IN THE TABLE ARE DESIGNED FOR A TEST PRESSURE OF 1000 kPa (100 m HEAD). ADJUST CONCRETE VOLUME TO SUIT ACTUAL TEST PRESSURE.
3. WHERE DI PIPES AND FITTINGS WITH RESTRAINED JOINTS ARE USED THRUST BLOCKS ARE NOT REQUIRED.
4. THRUST BLOCK REINFORCEMENT AS SPECIFIED IN DESIGN DRAWINGS.
5. WHERE SPECIFIED PROVIDE CONCRETE THRUST BLOCKS FOR SOC–SOC VALVES. THRUST AREA TO BE AS FOR DEAD ENDS AS SHOWN IN WS–004
6. INSTALL PUDDLE FLANGES ON CLASS K12 DICL PIPE.

STANDARDS NEW ZEALAND PAEREWA AOTEAROA
ORIGINAL SOURCE DRAWINGS: WATER SERVICES ASSOCIATION OF AUSTRALIA

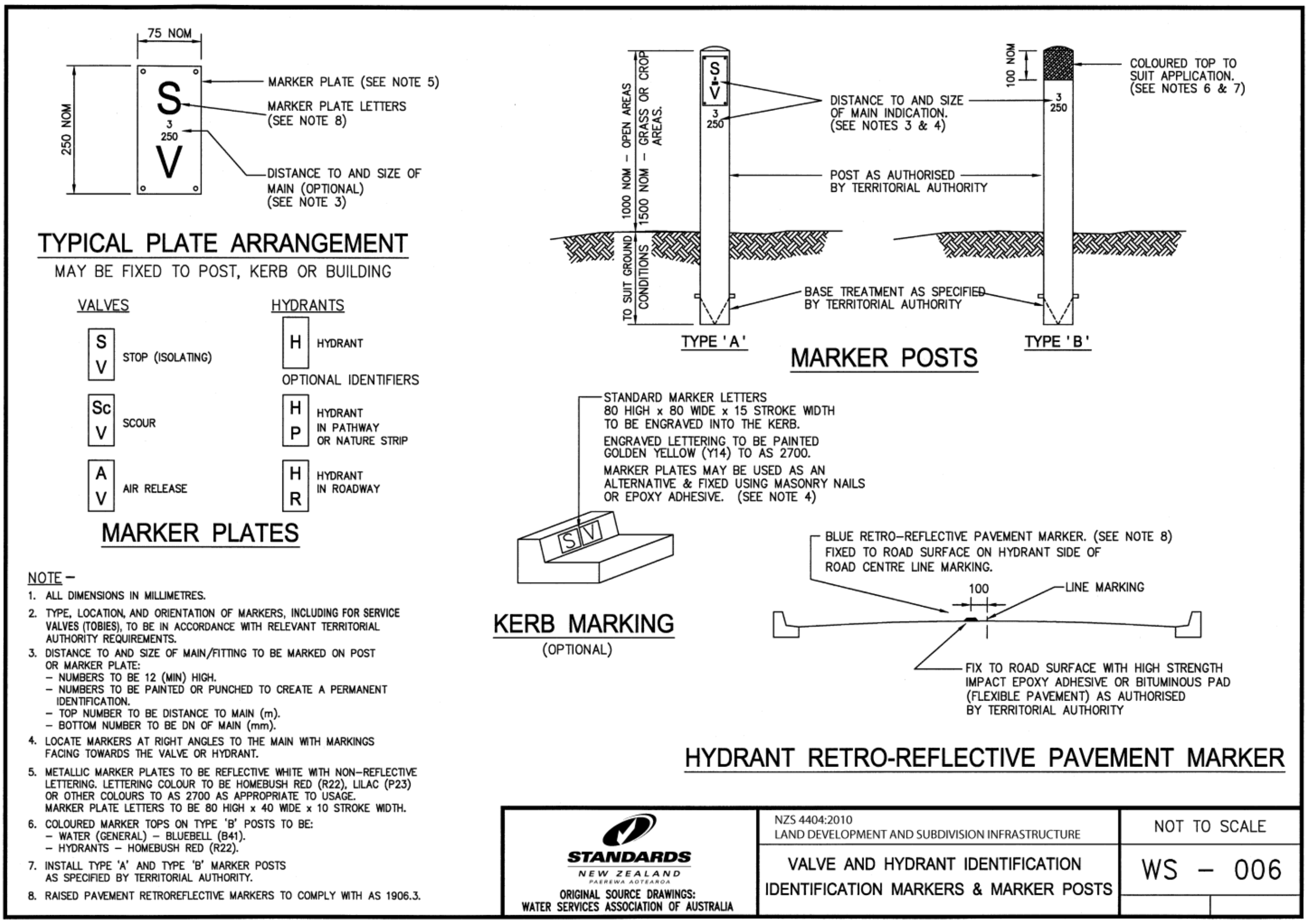
NZS 4404:2010
LAND DEVELOPMENT AND SUBDIVISION INFRASTRUCTURE

THRUST AND ANCHOR BLOCKS
GATE VALVES AND VERTICAL BENDS

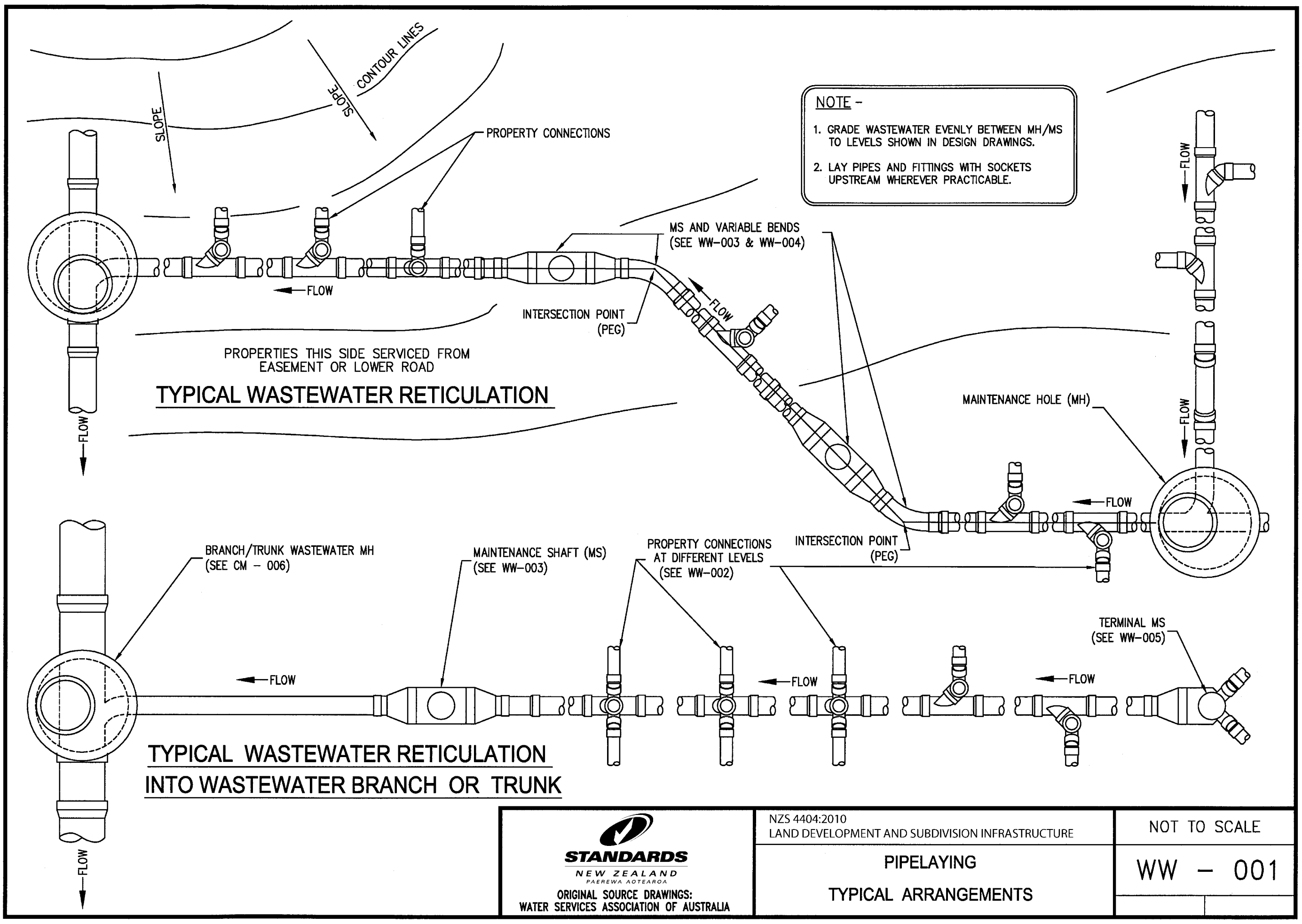
NOT TO SCALE

WS – 005

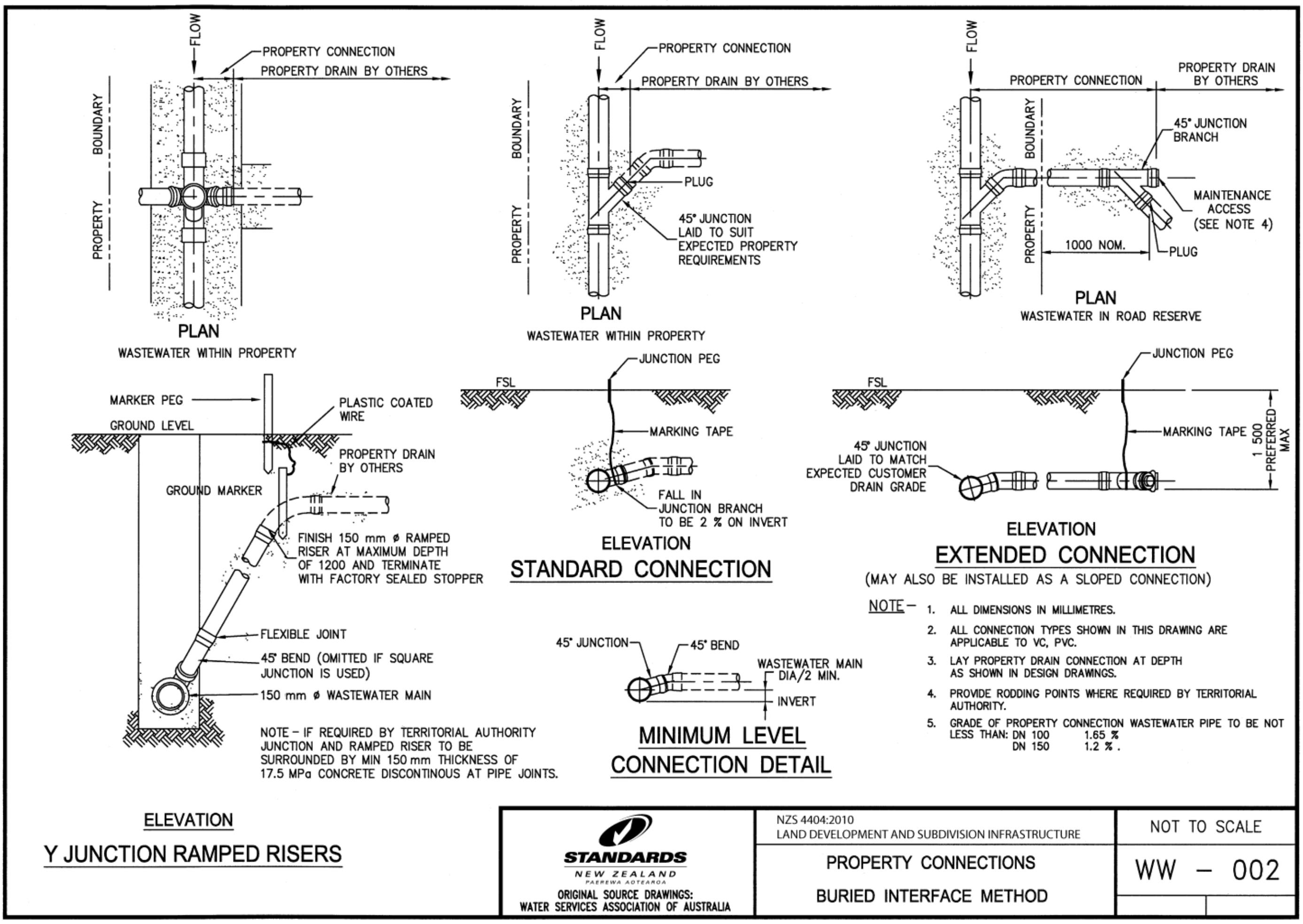
WS – 005 Thrust and anchor blocks – Gate valves and vertical bends



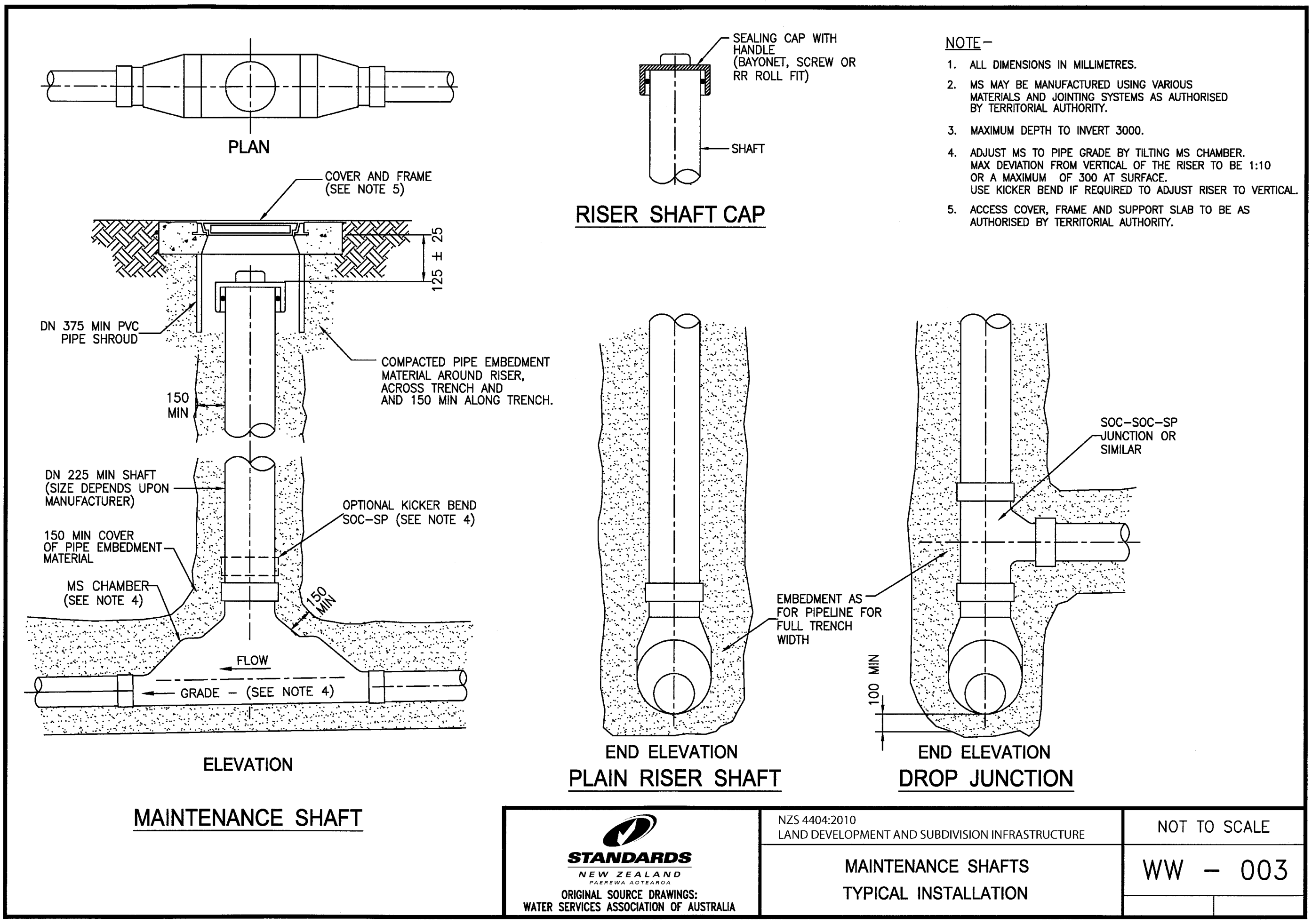
WS – 006 Valve and hydrant identification – Identification markers and marker posts



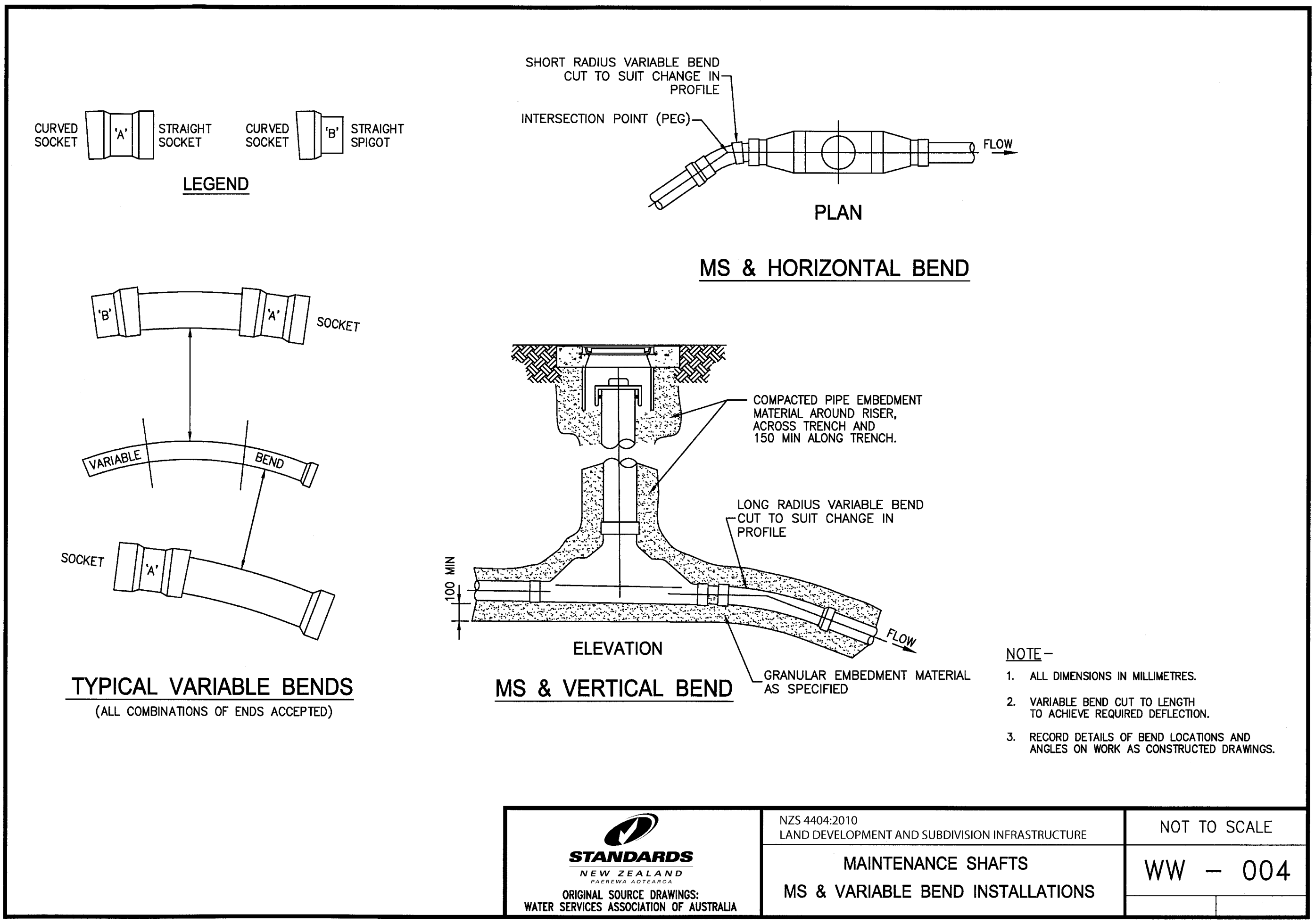
WW – 001 Pipelaying – Typical arrangements



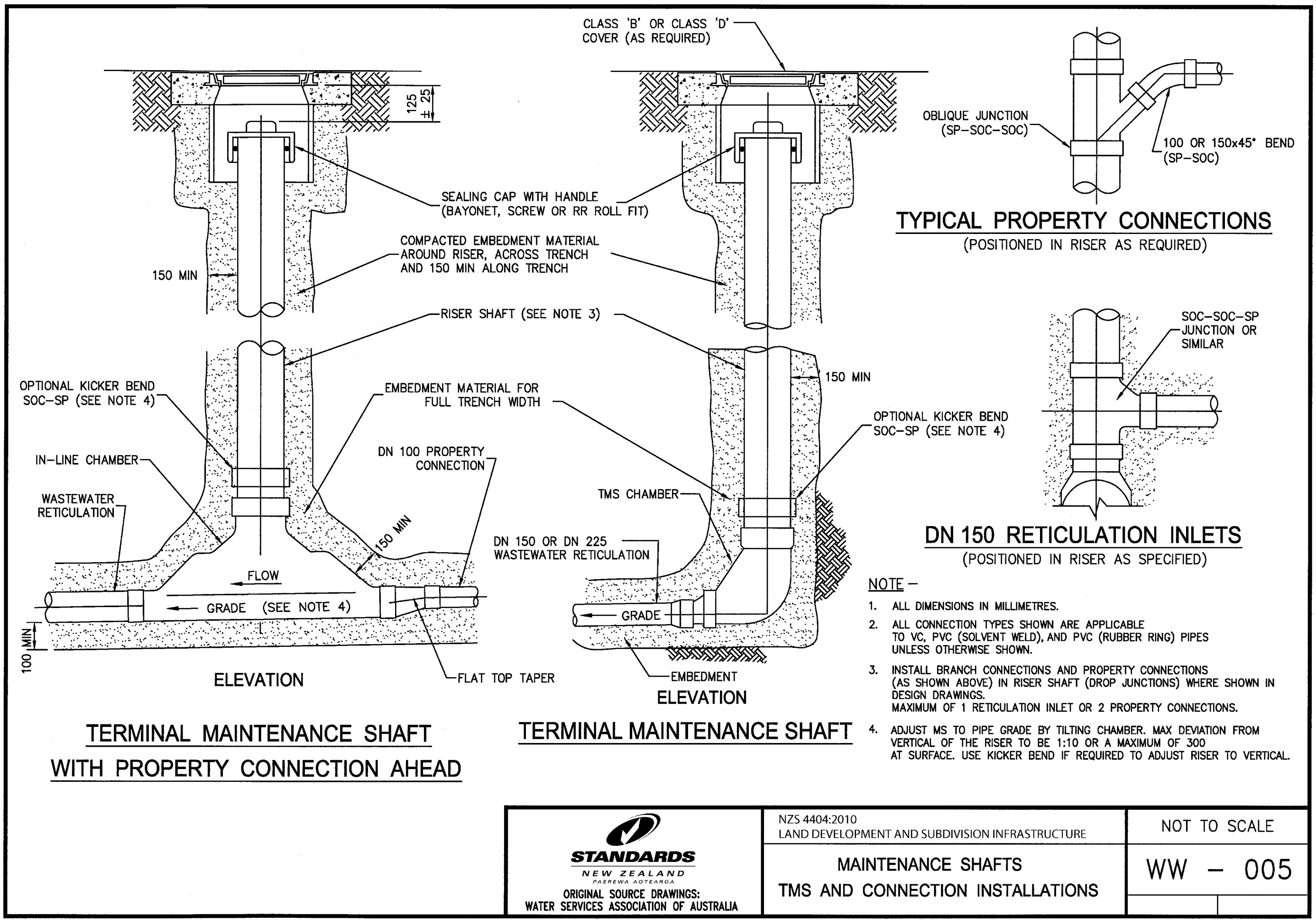
WW – 002 Property connections – Buried interface method



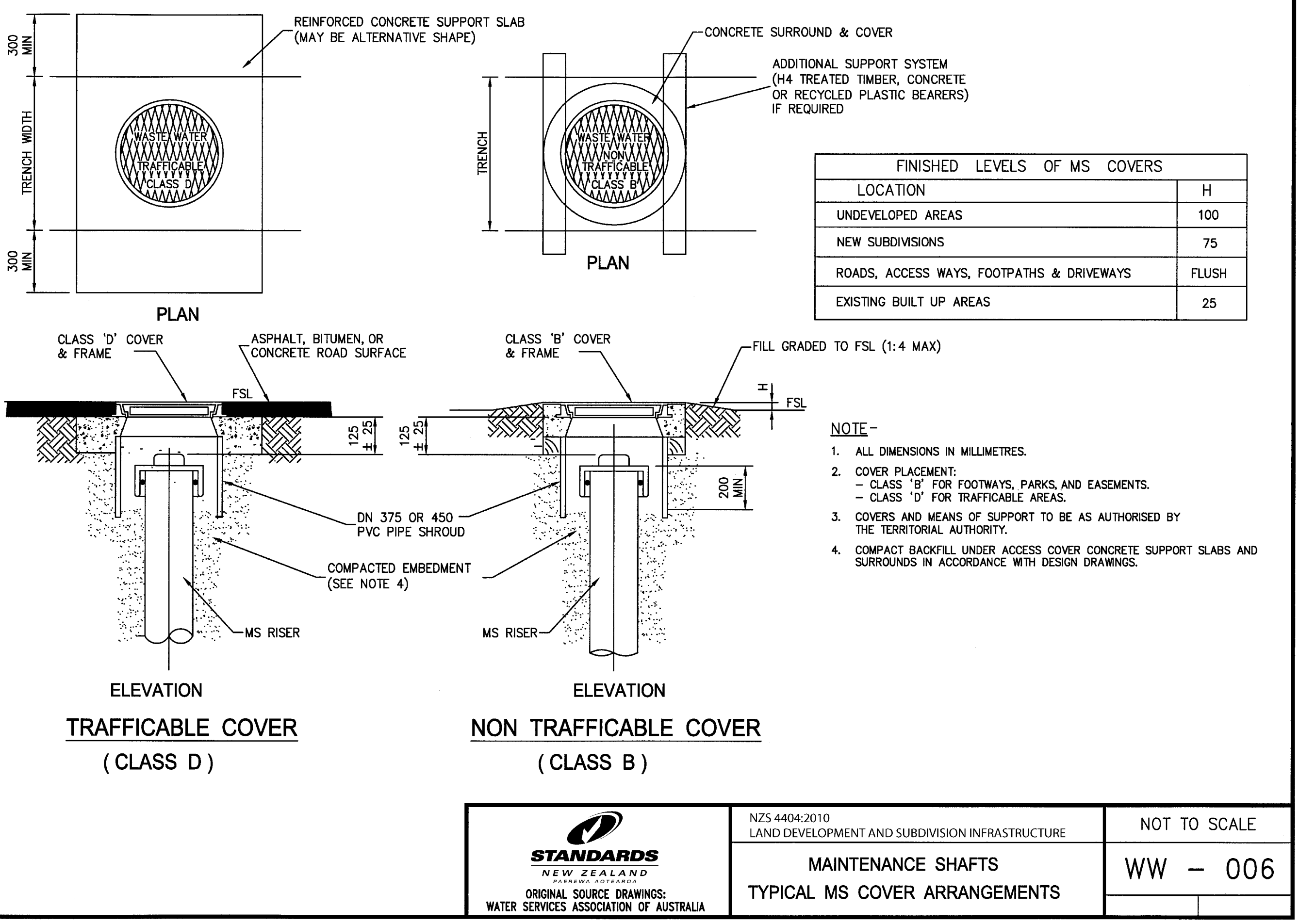
WW – 003 Maintenance shafts – Typical installation



WW – 004 Maintenance shafts – MS and variable bend installations



WW – 005 Maintenance shafts – TMS and connection installations



FINISHED LEVELS OF MS COVERS	
LOCATION	H
UNDEVELOPED AREAS	100
NEW SUBDIVISIONS	75
ROADS, ACCESS WAYS, FOOTPATHS & DRIVEWAYS	FLUSH
EXISTING BUILT UP AREAS	25

NOTE -

1. ALL DIMENSIONS IN MILLIMETRES.
2. COVER PLACEMENT:
   - CLASS 'B' FOR FOOTWAYS, PARKS, AND EASEMENTS.
   - CLASS 'D' FOR TRAFFICABLE AREAS.
3. COVERS AND MEANS OF SUPPORT TO BE AS AUTHORISED BY THE TERRITORIAL AUTHORITY.
4. COMPACT BACKFILL UNDER ACCESS COVER CONCRETE SUPPORT SLABS AND SURROUNDS IN ACCORDANCE WITH DESIGN DRAWINGS.

WW – 006 Maintenance shafts – Typical MS cover arrangements

Appendix C – Field testing of pipelines

(Normative)

C1 Scope

Appendix C is based on some of the test methods in AS/NZS 2566.2, section 6, and associated appendices. This appendix specifies suggested methods of test and their application to field testing of pipelines for the purpose of determining pipeline acceptability. Field testing includes leak or hydrostatic pressure testing, as appropriate, for pressure and non-pressure pipelines. Testing may also be carried out in accordance with the material-specific and application-specific test methods of AS/NZS 2032, AS/NZS 2033, and AS/NZS 2566.2.

C1.1 Purpose of field testing

The purpose of field testing is to:

(a) Reveal the occurrence of faults in the laying procedure, for example, joints incorrectly installed or pipes damaged;

(b) Reveal the occurrence of faults in the assembly procedure of pipeline components, for example, tapping bands, maintenance structures, frames, and covers;

(c) In the case of pressure pipelines, determine that the pipeline will sustain a pressure greater than its design pressure without leakage;

(d) In the case of non-pressure pipelines, determine that the pipeline satisfies the requirements for infiltration and exfiltration; and

(e) Test the installed structural integrity of the pipeline.

Field testing is not intended to supplement or replace the test requirements of product standards.

C2 Non-pressure pipelines – Field leakage testing

Leakage testing is used to reveal locations of potential infiltration and exfiltration due to the inclusion of damaged pipes, seals, or incorrectly made joints in the pipeline at the completion of installation.

Leakage testing for acceptance of non-pressure pipelines shall be carried out by at least one of the following methods:

(a) Low pressure air testing;

(b) Hydrostatic testing

NOTE – Air tests provide qualitative data only, as air pressure losses cannot be related directly to water leakage rates.

For pipeline test sections installed below the water table, and for submarine pipelines, the test pressure used for the hydrostatic test, and for the air test, shall be increased to maintain the required differential between internal and external pressure.

A pipeline failing to meet the requirements of the air tests may be retested using the hydrostatic test method.

NOTE – Failure is still probable.

C2.1 Low pressure air test

The test length shall be acceptable where the gauged pressure exceeds 18 kPa (or not more than 7 kPa less than the pressure at the start of the test) for the time interval shown in table C1 after the shut-off of the air supply.

Table C1 is based on an air test pressure of 25 kPa (in excess of any external hydrostatic pressure due to groundwater) and, on this basis, air volume losses shall not exceed the greater of:

(a) A rate of 0.0009 $m^3/(min \times m^2)$ of pipe wall area; and

(b) A rate of 0.056 m^3/min, which is regarded as the lowest detectable individual air leak.

Column 2 and column 3 of table C1 give the times and lengths up to which (b) prevails over (a).

NOTE – For safety reasons air test pressures in excess of 50 kPa should not be applied.

Table C1 – Low pressure air and vacuum tests – Minimum time intervals for 7 kPa pressure change in pipeline

DN	**Minimum time** (minutes)	**Maximum length for minimum time to apply** (metres)	**Test length** (metres)				
			50	**100**	**150**	**200**	**250**
			Minimum test duration (minutes)				
80	1.5	231	1.5	1.5	1.5	1.5	1.6
100	2	185	2	2	2	2	3
150	3	123	3	3	3	5	6
225	4	82	4	5	8	10	13
300	6	62	6	9	14	18	23
375	7	49	7	14	22	29	36
450	9	41	10	21	31	41	52
525	10	35	14	28	42	56	70
600	11	31	18	37	55	73	92
675	13	27	23	46	70	93	116
750	14	25	29	57	86	115	143
900	17	21	41	83	124	165	207
1000	19	19	51	102	153	204	255
1050	20	18.8	56	112	169	225	281
1200	23	15	73	147	220	294	367
1500	28	12	115	230	344	459	574

NOTE –
The time interval may be reduced for a proportionate reduction in the allowable pressure drop. Where there is no detectable change in pressure after 1 hour of testing, the section under test shall be deemed acceptable.
This table is based on the following equation:

$$T = 1.02 D_i k L q$$

where

T = time for a 7 kPa pressure drop, in seconds

D_i = pipeline internal diameter, in metres

q = allowable volume loss in cubic metre/minute/square metre taken as 0.0009 $m^3/min.m^2$

k = 0.054DL but not less than 1

L = length of test section, in metres.

Columns 2 and 3 have been calculated with k = 1.0.
The appropriate air or vacuum test/pressure method for pipes larger than DN 750 should be established by reference to the specifier.

C2.1.1 Low pressure air test procedure

The procedure shall be as follows:

(a) Pump in air slowly until a pressure of 25 +5,−0 kPa is reached. Where the pipeline is below the water table this pressure shall be increased to achieve a differential pressure of 25 kPa. In no circumstances should the actual pressure exceed 50 kPa;

NOTE – Rapid pressurisation may cause significant air temperature changes, which will affect the testing accuracy.

(b) Maintain the pressure for at least 3.0 minutes;

(c) Where no leaks are detected, shut off the air supply;

(d) Where the pipeline fails the test, repressurise to 25 +5,−0 kPa and check for leaks by pouring a concentrated solution of soft soap and water over accessible joints and fittings;

(e) Repair any defects, then repeat steps (a) to (c);

(f) With the air supply shut off, monitor the pressure for the time intervals given in table C1.

The test length shall be acceptable where the pressure drops by 7 kPa, or less, over the required (tabulated) test period.

NOTE –

(1) The test length of pipeline should be restricted to pipeline sections between maintenance holes (the most convenient places for inserting test plugs or fixing temporary bulkheads). The method should not be used for test lengths in excess of 250 m and for pipe diameters larger than 1500 mm.

(2) The procedure for low pressure air testing of large diameter pipelines is potentially hazardous because of the very large forces to be resisted by temporary plugs or bulkheads and the serious consequences of accidental bulkhead blow-out. A relief valve, with a 50 kPa maximum setting, should be installed on all pressurising equipment.

C2.2 Hydrostatic test

The test length shall be acceptable where the specified allowable make up water is not exceeded. Where not specified, the allowable make up water shall be 0.5 L/hour per metre length per metre diameter.

C2.2.1 Hydrostatic test procedure

The procedure shall be as follows:

(a) The test pressure shall be not less than 20 kPa, or 20 kPa above the groundwater pressure at the pipe soffit at its highest point, whichever is the greater, and not exceed 60 kPa at the lowest point of the section;

(b) Steeply graded pipelines shall be tested in stages where the maximum pressure, as stated above, will be exceeded if the whole section is tested in one length;

(c) The pressure shall be maintained for at least 2 hours by adding measured volumes of water where necessary;

(d) Any visible leaks detected shall be repaired and the pipeline shall be retested.

C3 Pressure pipelines – Field hydrostatic pressure testing

The hydrostatic pressure test method shall be as specified.

Hydrostatic pressure testing requires selecting an appropriate configuration of method, pressure, and length of test section.

Test parameters and details shall be determined with due consideration to the following:

(a) Pipe material;

(b) Pipe diameter;

(c) Length of test section;

(d) Duration of the test;

(e) Magnitude of test pressure and rate of pressurisation;

(f) Presence of air in the pipeline;

(g) Time required for saturation of porous liners;

(h) Potential movement of pipeline thrust restraints;

(i) Design pressure for thrust and anchor supports;

(j) Accuracy of test equipment;

(k) Ambient temperature changes during testing;

(l) Presence of leaks in equipment used for testing or equipment attachment points (such as sealing plugs);

(m) Potential for leaks in the pipeline.

NOTE – It is advisable to begin testing early in the pipeline installation to confirm adequacy of laying procedures and, where appropriate, to increase the length tested progressively as experience is gained.

C3.1 Selection of test pressure

The hydrostatic test pressure at any point in the pipeline shall be:

(a) Not less than the design pressure; and

(b) Not more than 25% above the rated pressure of any pipeline component.

NOTE – The design pressure is the maximum system pressure at a point in the pipeline, considering future developments, static pressure, dynamic pressure, and an allowance for short-term surge pressure (water hammer), as determined by analysis.

Compressed air testing shall not be permitted for pressure pipe.

C3.2 Selecting test lengths

The pipeline length tested shall be either the whole, or a section (capable of being isolated), of the pipeline depending on the length and diameter, the availability of water, and the spacing between sectioning valves or blank ends.

The pipeline shall be divided into test sections such that:

(a) The hydrostatic test pressure at any point in the pipeline is:

(i) Not less than the design pressure; and

(ii) Not more than 25% above the rated pressure of any pipeline component; and

(b) Water is available for the test together with facilities for its disposal, in accordance with regulatory requirements, after the test.

NOTE –

(1) Pipelines longer than 1000 m may need to be tested in several sections. Where long lengths are to be tested, radio or other electronic means of communication between test operatives, to coordinate test procedures and thus minimise the test duration, is desirable.

(2) Long test sections may incorporate a large number of mechanical (that is, flanged) joints,

which should be checked for leakage. The longer the test section the harder it is to locate a leak, or discriminate between a leak and the other effects, such as the absorption of air into solution under pressure.

C3.3 Pre-test procedures

The pre-test procedures are as follows:

(a) All required temporary and permanent thrust blocks, or other pipeline thrust-resisting methods, including integral joint-restraint systems, shall be in place, and all concrete shall be adequately cured (normally a minimum of 7 days);

(b) Blank flanges or caps shall be installed at the beginning and end of the test section. Testing shall not take place against closed valves unless they are fully restrained and it is possible to check for leakage past the valve seat. Mechanical ends that are not end load resistant shall be temporarily strutted or anchored, to withstand the test pressures without movement;

NOTE – Temporary supports should not be removed until the pipeline has been depressurised. All test personnel should be informed of the loading limits on temporary fittings and supports.

(c) Where practicable, all bolted joints shall be left exposed to allow for re-tensioning during or after testing;

(d) Compacted embedment and fill material shall be placed to leave all joints, service connections and ball valves exposed wherever possible;

(e) For PE pipelines, the pressurising time shall not exceed 45 minutes;

NOTE – The pressurising time affects the duration of the PE pipeline test.

(f) The test equipment shall be placed in position and checked for satisfactory operation;

(g) The pump shall be of adequate size to raise and maintain the test pressure;

NOTE – A pump that is too small may increase the test duration or where too large it may be difficult to control the pressure.

(h) Two calibrated test gauges shall be used to cross check gauge accuracy;

(i) Slowly fill the test length of pipeline with water, preferably from the lowest point, ensuring air is vented at the high point valves. Allow a period, in the range of 3 hours to 24 hours, for the temperature of the test length and the test water to stabilise and for dissolved air to exit the system. The recommended rate of filling shall be based on a flow velocity of 0.05 m/s, calculated from the following equation:

$$Q\mathrm{f} \leq 12.5\pi D^2$$

where

$Q\mathrm{f}$ = filling rate, in litres per second

D = pipe diameter, in metres

NOTE – The slow rate of 0.05 m/s avoids air entrainment when the filling water is cascading through downward gradients along the pipeline.

The period of stabilisation will depend on pipe dimensions, length, material, longitudinal profile, and air exit points. For cement-mortar lined pipe, the pipeline shall be filled at least 24 hours before the commencement of the test, to allow the lining to become saturated.

NOTE – A firm foam swab may be used ahead of the fill water to assist air removal especially where the pipeline undulates. Extract the swab at a high-point wash-out.

Typical pressure test equipment and location are shown in figures C1 and C2.

C3.4 Post-test procedures

After testing, pipelines shall be depressurised slowly. All air venting facilities shall be open when emptying pipelines. The test water shall be drained to an approved waterway and all connection points shall be reinstated.

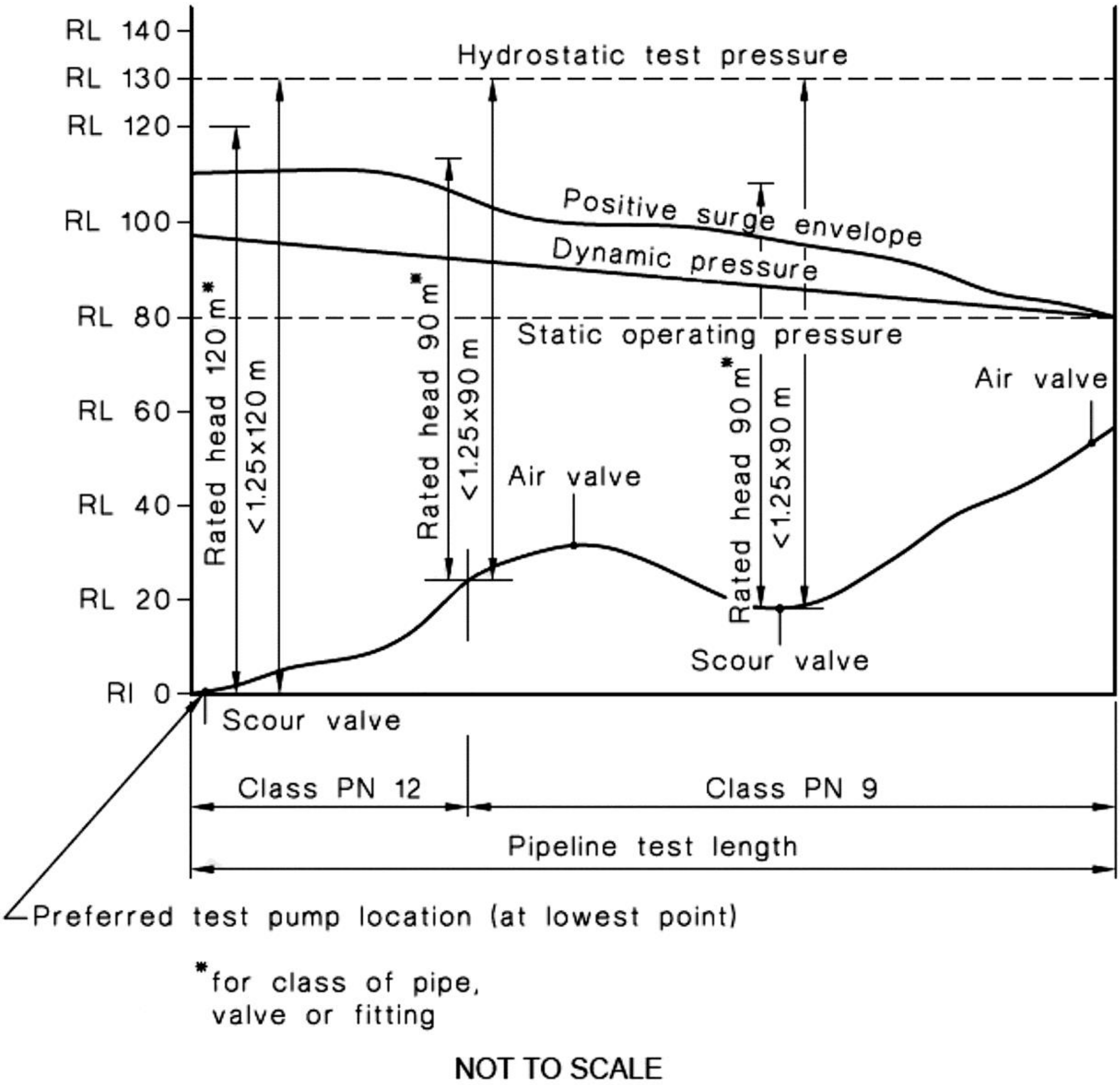


Figure C1 – Typical pressure pipeline under field hydrostatic test

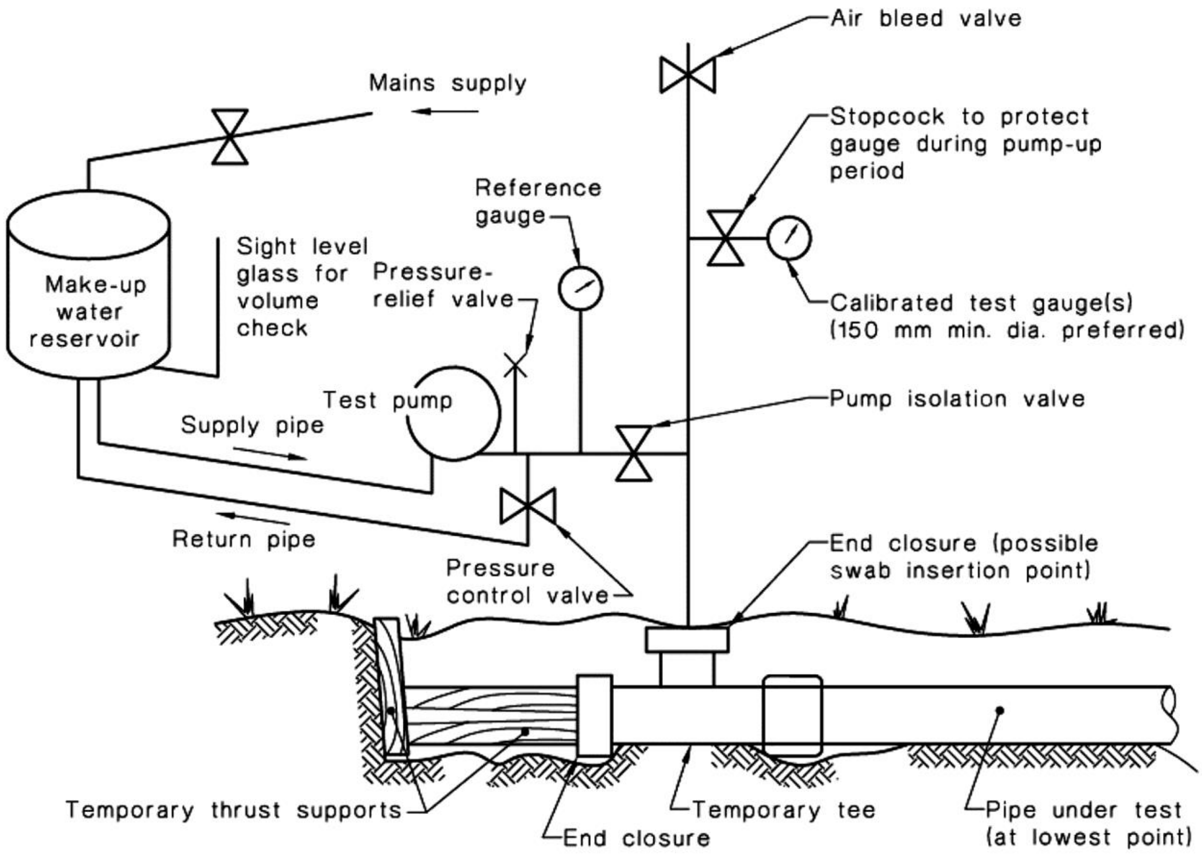


Figure C2 – Typical field pressure test equipment layout

C3.5 Constant pressure test (water loss method) – PVC, DI, GRP, and steel pipelines

This test is applicable for PVC, DI, GRP, and steel pipelines. The test length may be several kilometres in length (see C3.2).

C3.5.1 Procedure

The procedure shall be as follows:

(a) Close all valves apart from the test pump input and pressurise the test length to the specified test pressure (STP) – (see C3.1);

(b) Apply and then maintain the test pressure by the addition of measured and recorded quantities of make-up water at regular intervals over a period, in the range of 1 hour to 12 hours;

(c) Where pressure measurements are not made at the lowest part of the test length, make an allowance for the static head, between the lowest point of the pipeline and the point of measurement, to ensure that the test pressure is not exceeded at the lowest point.

The quantity of make-up water necessary to maintain the test pressure shall comply with the following equation:

$$Q \leq 0.14LDH$$

where

Q = allowable make-up water, in litres per hour

L = length of the test length, in kilometres

D = nominal diameter of the test length, in metres

H = average test head over length of pipeline under test, in metres

NOTE – The make-up water is not a leakage allowance, but is an allowance to cover the effects of the test head forcing small quantities of entrapped air into solution. Normally the test should last for a minimum of 2 hours and be concluded within 5 to 8 hours. The make-up water requirement should reduce with time as air goes into solution. Where, after 12 hours the make-up water still exceeds the allowable limit, testing should cease and the cause of loss investigated.

C3.5.2 Acceptance

(a) The test length shall be acceptable where there is no failure of any thrust block, pipe, fitting, joint, or any other pipeline component;

(b) There is no physical leakage;

(c) The quantity of make-up water necessary to maintain the test pressure complies with C3.5.1.

C3.6 Constant pressure test (water loss method) for viscoelastic pressure pipelines

This test is applicable to PE, PP, and ABS pressure pipelines. The test lengths may be several kilometres in length.

NOTE – This method is based on VAV P78, as outlined in AS/NZS 2566.2, Appendix A.

C3.6.1 Procedure

The procedure shall be as follows:

(a) Purge the air from pipeline;

(b) Apply the specified test pressure (STP) (see C3.1) to the test length;

(c) Shut off main and allow pressure to settle for 12 hours (pressure will drop significantly);

(d) Re-apply and maintain test pressure for 5 hours by successively pumping a sufficient amount of water;

(e) Measure and record water volume (V_1 in litres) required to maintain this pressure between Hour 2 and Hour 3;

(f) Measure and record water volume (V_2 in litres) required to maintain this pressure between Hour 4 and Hour 5;

(g) Calculate:

$$0.55V_1 + Q$$

where Q is the allowable make-up volume obtained from C3.5.1.

C3.6.2 Acceptance

The test length shall be acceptable where:

(a) The test length shall be acceptable where there is no failure of any thrust block, pipe, fitting, joint, or any other pipeline component;

(b) There is no physical leakage; and

(c) $V_2 \leq 0.55\ V_1 + Q$.

C3.7 Pressure rebound method for viscoelastic pressure pipelines

This test is applicable to PE, PP, and ABS pressure pipelines up to and including DN 315, where a short test time is required.

NOTE – This test is based on BS EN 805:2000, Appendix A (refer to AS/NZS 2566.2).

C3.7.1 Pressure measurement rig

The test rig shall be a recently calibrated pressure transducer, data logger, and check pressure gauge that has a dial of at least 100 mm diameter and a pressure range that places the specified test pressure (STP) (see C3.1) in the range 35% to 70% of the gauge's full scale. The transducer and the check gauge shall read within ±5% of each other. If they do not agree within this tolerance, the equipment shall be recalibrated or replaced.

C3.7.2 Procedure

The test procedure has the following three phases:

(a) A preliminary phase in which the pipeline is —

   (i) Depressurised and allowed to relax after the C3.3 pre-test procedure

   (ii) Pressurised quickly to the test pressure and maintained at this pressure for a period of time without further water being added

   (iii) The pressure is allowed to decay by viscoelastic creep, and

   (iv) Provided the pressure drop does not exceed a specified maximum, the pressure test can proceed to the second phase;

(b) A phase in which the volume of air remaining in the pipeline is assessed against an allowable maximum;

(c) The main test phase in which the pipeline is maintained at the test pressure for a period of time and decay due to viscoelastic creep commenced. The creep is interrupted by a rapid reduction of the pressure in the pipeline to a specified level. This rapid reduction in pressure results in contraction of the pipeline with an increase (rebound) in pressure. If, during the rebound period, the pressure versus time record shows a fall in pressure, the pipeline fails the test.

C3.7.3 Preliminary phase

The procedure shall be as follows:

(a) Reduce pressure to just above atmospheric at the highest point of the test length, and let stand for 60 minutes. Ensure no air enters the line;

(b) Raise the pressure smoothly to STP in less than 10 minutes. Hold the pressure at STP for 30 minutes by pumping continuously, or at short intervals as needed. Do not exceed STP;

(c) Inspect for leaks during the 30 minute period, then shut off pressure;

(d) Allow the pressure to decay for 60 minutes;

(e) Measure the pressure remaining at 60 minutes (P_{60});

(f) If $P_{60} \leq 70\%$ of STP the test is failed. The cause shall be located and rectified. Steps (a) to (e) shall be repeated. If $P_{60} > 70\%$ of STP, proceed to the air volume assessment.

C3.7.4 Air volume assessment

The procedure shall be as follows:

(a) Quickly (<5 min) reduce pressure by ΔP (10%–15% of STP);

(b) Measure water volume bled out (ΔV);

(c) Calculate $\Delta V_{max\ allowable}$ as follows:

$$\Delta V_{max\ allowable} = 1.2 \times V \times \Delta P\,(1/E_W + D/E_R)$$

where

1.2	=	air allowance
V	=	pipe volume, in litres
ΔP	=	measured pressure drop, in kilopascals
D	=	pipe internal diameter, in metres
E_R	=	pipe material modulus, in kilopascals (see table C2)
E_W	=	bulk modulus of water, in kilopascals (see table C3);

(d) If $\Delta V > \Delta V_{max\ allowable}$ the test has failed. The cause shall be located and rectified. The preliminary phase shall be repeated. If $\Delta V \leq \Delta V_{max\ allowable}$, proceed to the main test phase.

NOTE – ΔV and ΔP should be measured as accurately as possible, especially where the test length volume is small.

C3.7.5 Main test phase

Observe and record the pressure rise for 30 minutes.

In the event of failure, locate and repair leaks. If failure is marginal or doubtful, or if it is necessary to determine leakage rate, use a reference test (see C3.6).

NOTE – Figure C3 gives an example of a full pressure test with the main test phase extended to 90 minutes.

Table C2 – Pipe E material modulus for PE 80B and PE 100

Temp (°C)	**PE 80B – *E* Modulus** (kPa×10^3)			**PE 100 – *E* Modulus** (kPa×10^3)		
	1 h	**2 h**	**3 h**	**1 h**	**2 h**	**3 h**
5	740	700	680	990	930	900
10	670	630	610	900	850	820
15	600	570	550	820	780	750
20	550	520	510	750	710	680
25	510	490	470	690	650	630
30	470	450	430	640	610	600

Table C3 – Bulk modulus *E*w – Water

Temperature (°C)	**Bulk Modulus** (kPa×10^3)
5	2080
10	2110
15	2140
20	2170
25	2210
30	2230

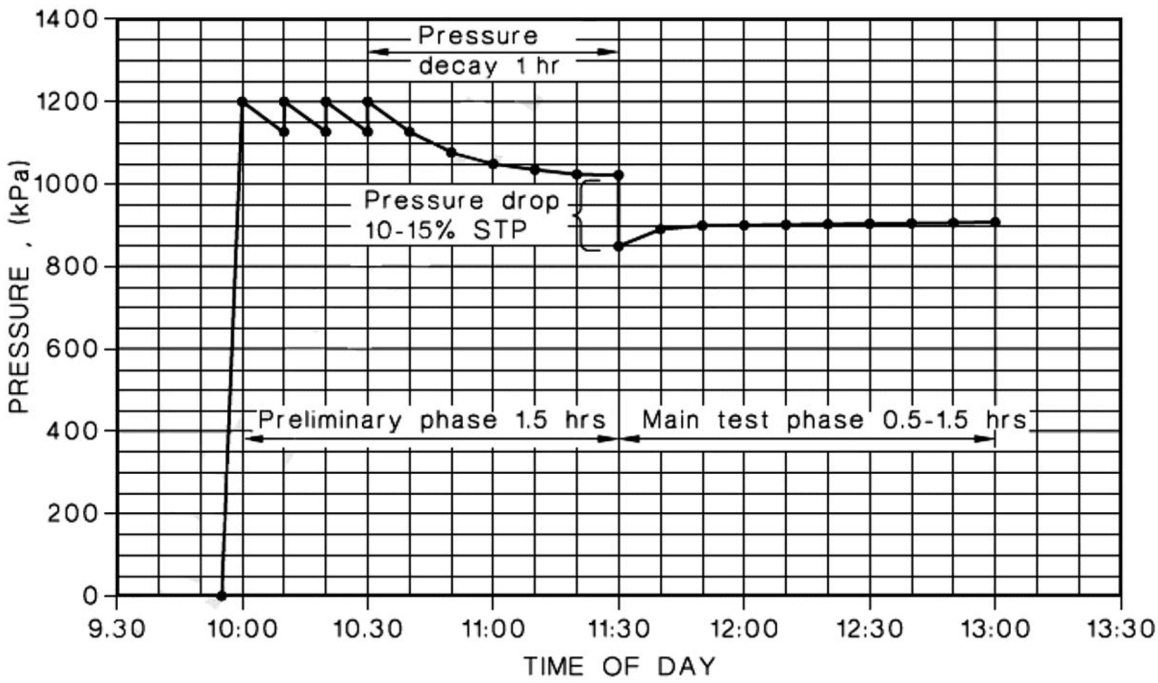


Figure C3 – Typical successful modified rebound test for a PE pipeline

C3.7.6 Acceptance

The test length shall be acceptable if:

(a) There is no failure of any thrust block, pipe, fitting, joint, or any other pipeline component;

(b) There is no physical leakage;

(c) The pressure rises or remains static in the 30-minute period.

If doubt exists about the pressure recovery, the monitoring period may be increased to 90 minutes, and any pressure drop that does occur shall not exceed 20 kPa over the 90-minute period.

If the pressure drops by more than 20 kPa during the 90-minute extended period, the test fails.

Repetition of the main test phase shall only be done by carrying out the whole test procedure, including the relaxation period of 60 minutes described in C3.7.3.

C3.8 Visual test for small pressure pipelines

This test is applicable for small pipelines of all materials (less than 200 m in length), and pipelines where pipeline joints have been left exposed for the test operation (such as coiled pipe).

C3.8.1 Procedure

The procedure shall be as follows:

(a) The test pressure (see C3.1) shall be applied and the test section isolated by closing the high point air release valves and the pump feed valve;

(b) The test section shall be visually inspected for leakage at all joints, especially bolted joints, all fittings, service connections, and ball valves;

(c) Pressure gauges shall be checked to ensure that pressure has not fallen significantly indicating an undetected leak;

(d) Any detected leak shall be repaired and the section shall be retested;

(e) Where no leak is detected, high point air release valves shall be opened, the pipeline shall be depressurised to slowly drain the line into an approved waterway and all connection points shall be reinstated.

C3.8.2 Acceptance

The test length shall be acceptable where:

(a) There is no failure of any thrust block, pipe, fitting, joint, or any other pipeline component;

(b) There is no physical leakage; and

(c) There is no pressure loss indicative of a leak.

Appendix D – Water supply disinfection specification

(Normative)

D1 Disinfection of pipelines and fittings

After flushing the main to remove all debris and air, the main shall be filled with water containing a free available chlorine concentration of 15 g/m^3 ± 5 g/m^3 and allowed to stand for a minimum of 12 hours for all new mains. At the end of the disinfection period, the free available chlorine (FAC) concentration shall be at least 5 g/m^3. If the FAC is less than 5 g/m^3 at the completion of the period, the disinfection shall be repeated until a satisfactory result is obtained. Note that the main should not be drained after flushing unless all high points are 'vented' to allow for complete removal of air.

Under no circumstances will the use of handfuls of hypochlorite powder or chlorine tablets dumped into the pipe and hydrant tees be an acceptable practice.

The sterilising solution should be fed by gravity or pumped into one end of the main and the 'flushing' water in the pipe displaced out of the opposite end of the main until tests carried out show that the water being displaced contains the full FAC concentration. The authorised officer will arrange for testing of the FAC concentration and, to this end, the contractor shall give 24-hours notice of intention to sterilise.

The contractor shall provide all temporary fittings necessary to allow for the introduction of the sterilising solution to and its removal from the main.

See also D3.

D2 Methods of introducing the sterilising solution

Methods of introducing sterilising solution will depend on the volume of solution required for the particular main and the availability of appropriate equipment.

In general, wherever the pipe volume is less than 10 m^3, the most practical method is to add sufficient calcium or sodium hypochlorite (powder or solution) to a potable water tanker suitable for carrying potable water to achieve the desired 15 g/m^3 FAC concentration. (This may require two tankers full.)

For greater quantities, the sterilising solution may be injected into the main using a portable gas chlorinator or a hypochlorinator. An approved backflow preventer shall be installed if either of these options is used.

D3 Disposal of sterilising solution

After the satisfactory completion of the sterilising process, the chlorine solution shall be flushed into the sanitary wastewater pipe or, alternatively, retained in a temporary surface storage pond until the TA's authorised officer is satisfied that the FAC has reduced to a satisfactory concentration before being allowed to flow down the stormwater drainage system or into a natural watercourse.

D4 Acceptable method for sterilising mains

(a) Use sodium hypochlorite solution. This solution usually has 10% or 15% FAC;

(b) Obtain a clean water tanker, as used for potable drinking water. The tanker should have a known water capacity;

(c) Measure the required amount of sodium hypochlorite solution into a beaker and pour it into the empty tanker;

NOTE – The final strength of the chlorine to water is to be 15 g/m^3 ±5 g/m^3.

(d) Fill the tanker to the appropriate volume and ensure the solution is well mixed;

(e) Charge the new main with the chlorinated water from the tanker at one end of the main or into a new hydrant through a standpipe. All service pipes and hydrants shall be left open and allowed to run for a couple of minutes. The services and hydrants shall then be closed to allow the highest end of the main to fill completely;

NOTE – The main should ideally be charged from the highest point. This will allow the water to be gravity fed into the main. If this is not possible the water tanker shall have a truck mounted pump to pump the chlorinated water in.

(f) Seal off the main and leave it charged with the chlorinated water for 24 hours;

(g) Take samples and test for residual chlorine;

(h) After 24 hours flush the main well until the chlorine smell is gone. Once the main is connected into the reticulation system it should be flushed thoroughly before the services are connected up.

NOTE – For large mains, a water tanker may not have the required capacity so a dose pump system shall be used and approved by the authorised officer.

Example:

A. Calculate the volume of the mains to be chlorinated, that is, 85 m of 100 mm dia. main

$$\text{Vol.} = \frac{85 \times \pi \times 0.1^2}{4} = 0.67 \text{ m}^3$$

$$= 667.6 \text{ litres}$$

Plus 110 m of 150 mm dia. main

$$\text{Vol.} = \frac{110 \times \pi \times 0.15^2}{4} = 1.944 \text{ m}^3$$

$$= 1.944 \text{ litres}$$

Total volume = 1,944 + 667.6 = 2,611.6 litres

B. The total volume of 2,611.6 litres is less than the volume of the water tanker (say 5,000 litres) so calculate how many millilitres of sodium hypochlorite is required for the 5,000 litre tanker to give a final solution of 15 g/m^3.

$$v = \frac{V \times c}{s \times 10}$$

v = volume of sodium hypochlorite in ml

V = volume of water tanker

c = concentration of final solution in g/m^3

s = strength of concentrated hypochlorite in % FAC

$$v = \frac{5000 \times 15}{15 \times 10} = 500 \text{ ml}$$

Appendix E – Typical plan and cross section figures from table 3.2

(Informative)

The following figures are provided by Standards New Zealand. The copyright of these figures is waived.

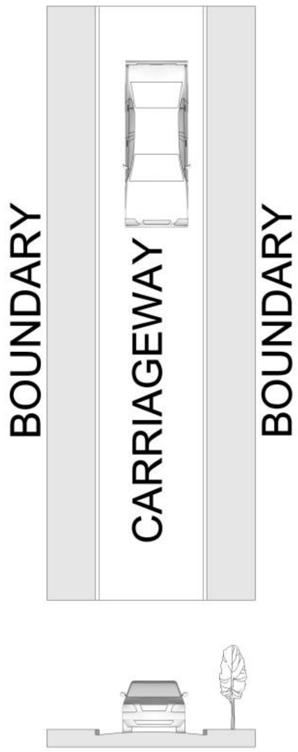


Figure E1 – Rural, live and play, access to lifestyle or clustered housing (1 to 6 du)

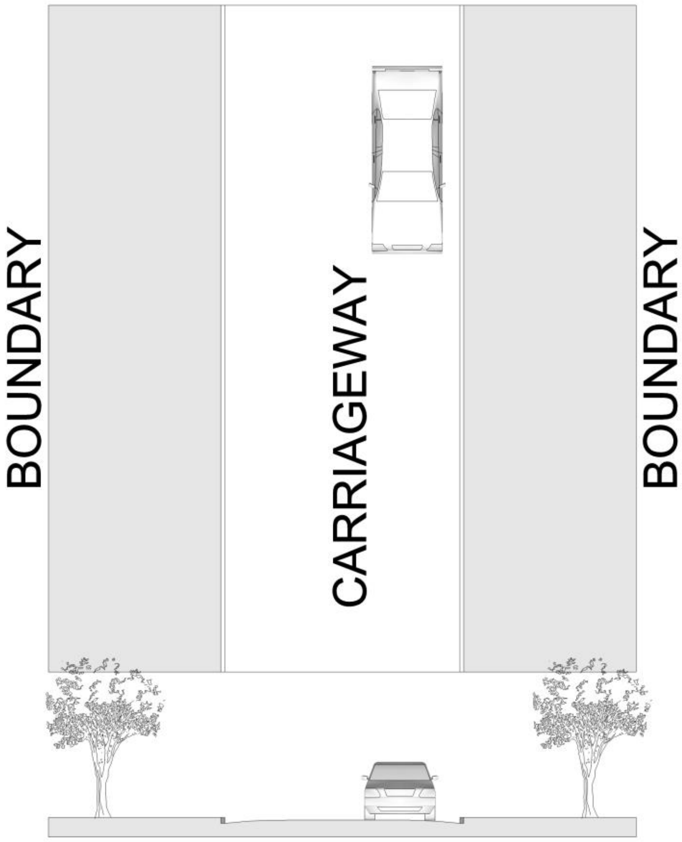


Figure E2 – Rural, live and play, access to lifestyle or clustered housing (1 to 20 du)

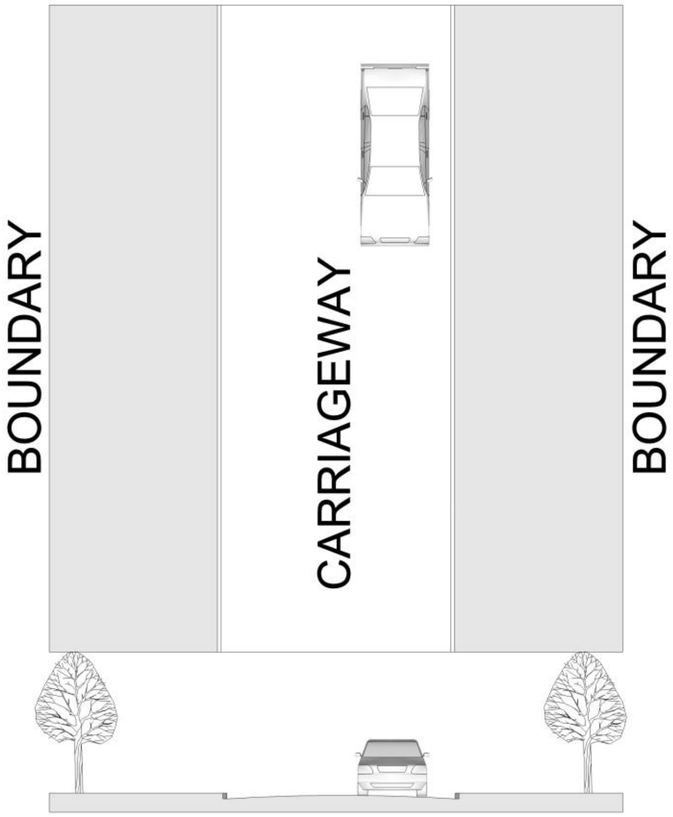


Figure E3 – Rural, live and play, access to housing

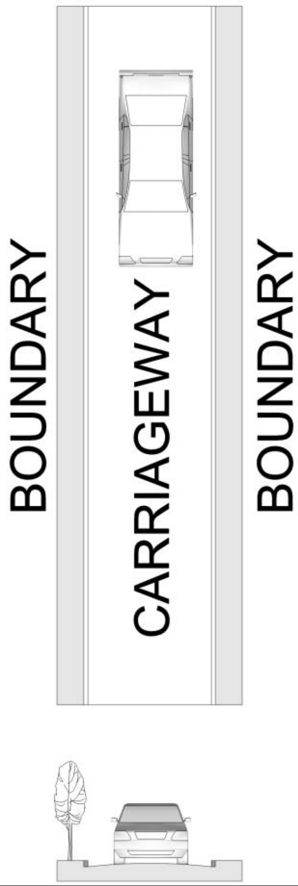


Figure E4 – Rural, shop and trade, side or rear service access

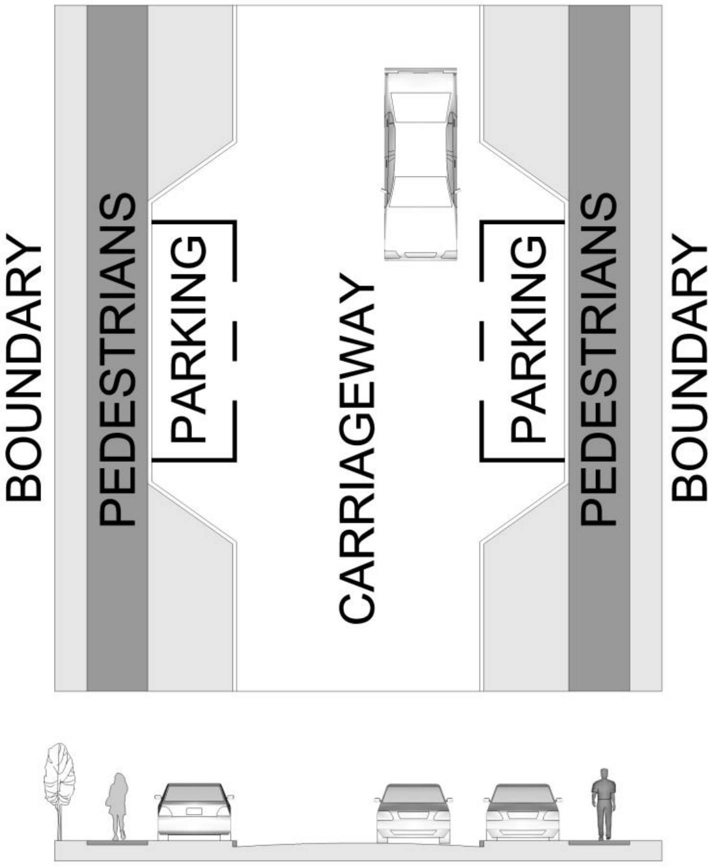


Figure E5 – Rural, shop and trade, access to trade

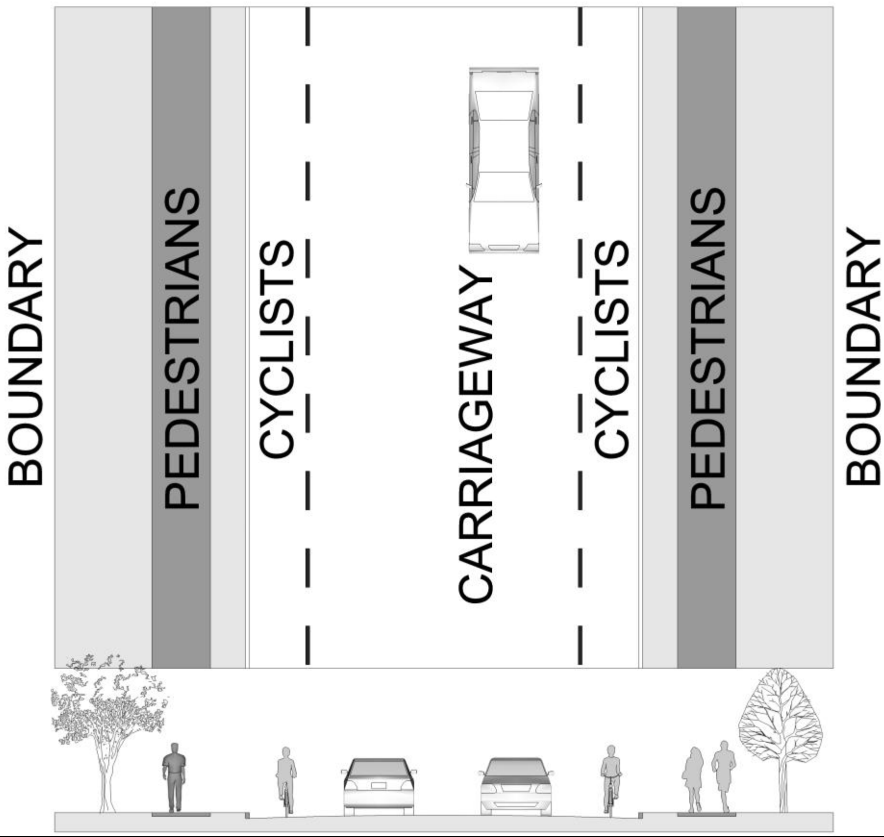


Figure E6 – Rural, make and move, primary freight access

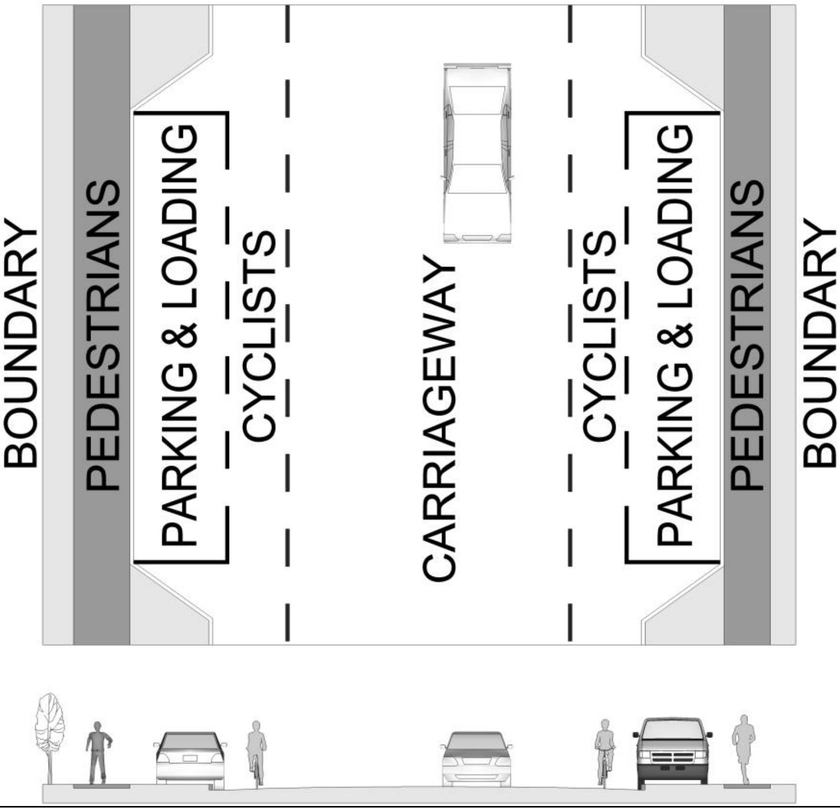


Figure E7 – Rural, make and move, access to office and education

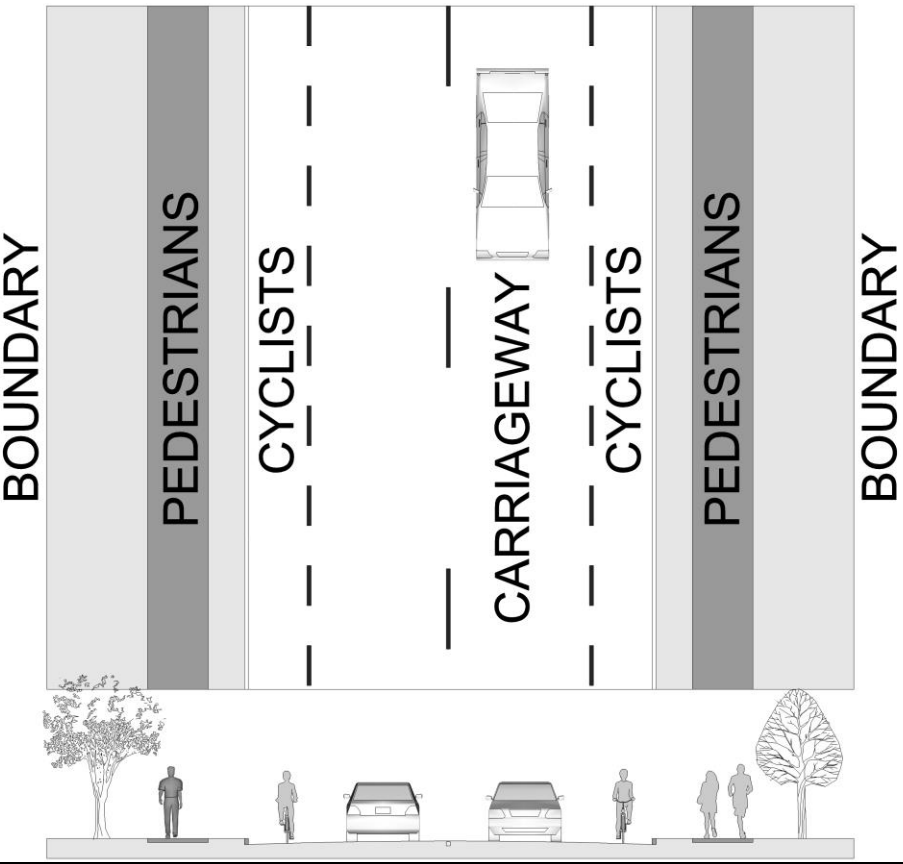


Figure E8 – Rural, all other situations (where not specified elsewhere in table 3.2)

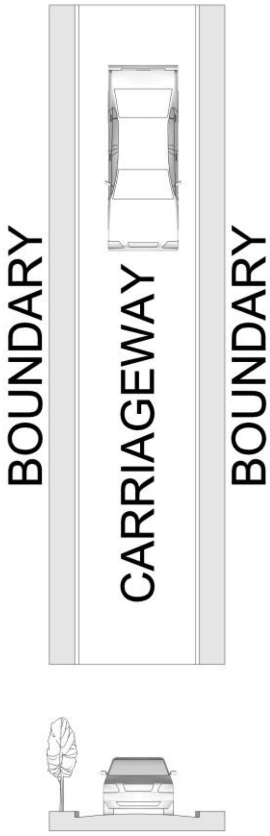


Figure E9 – Suburban, live and play, access to houses/townhouses (1 to 3 du, or 1 to 6 du)

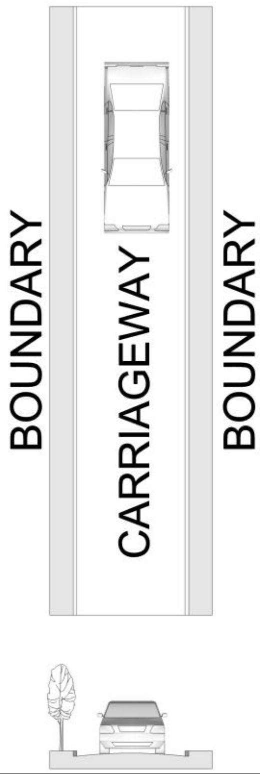


Figure E10 – Suburban, live and play, side or rear service access

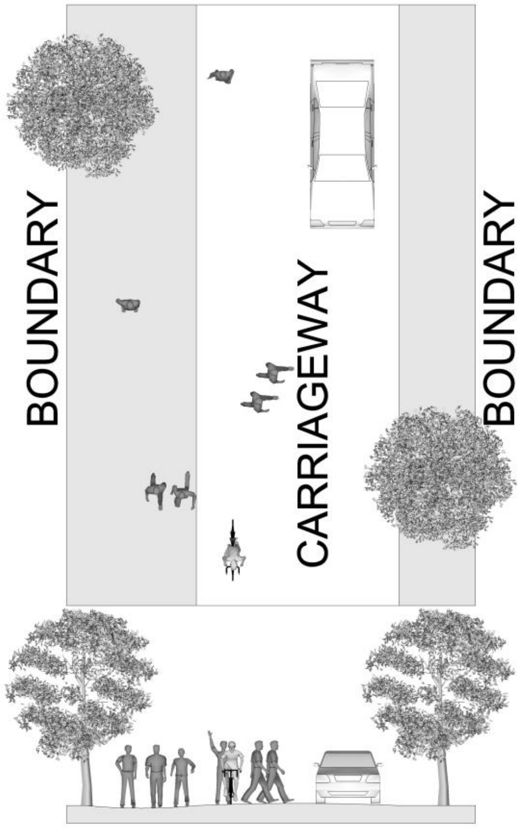


Figure E11 – Suburban, live and play, access to houses/townhouses (1 to 20 du)

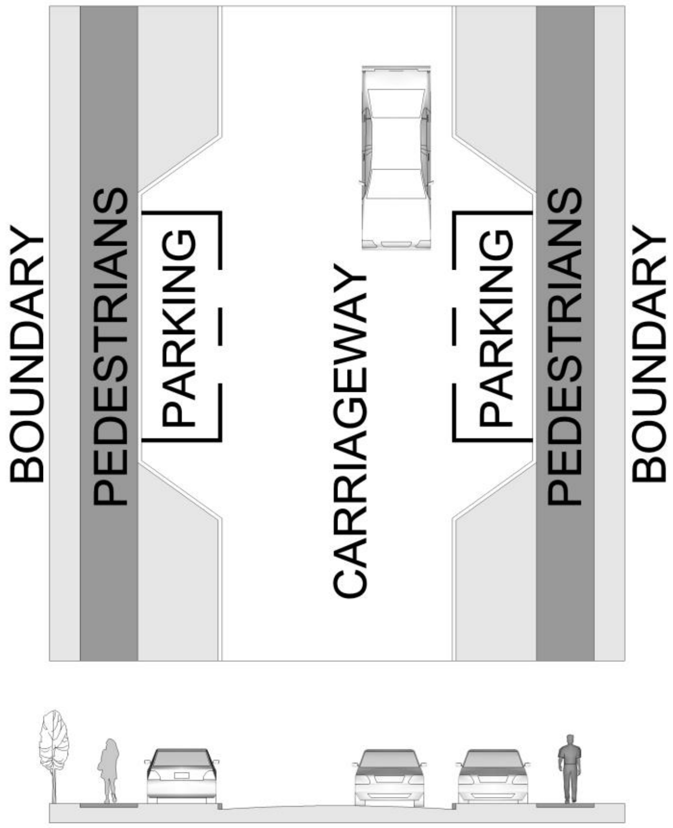


Figure E12 – Suburban, live and play, primary access to housing (1 to 200 du)

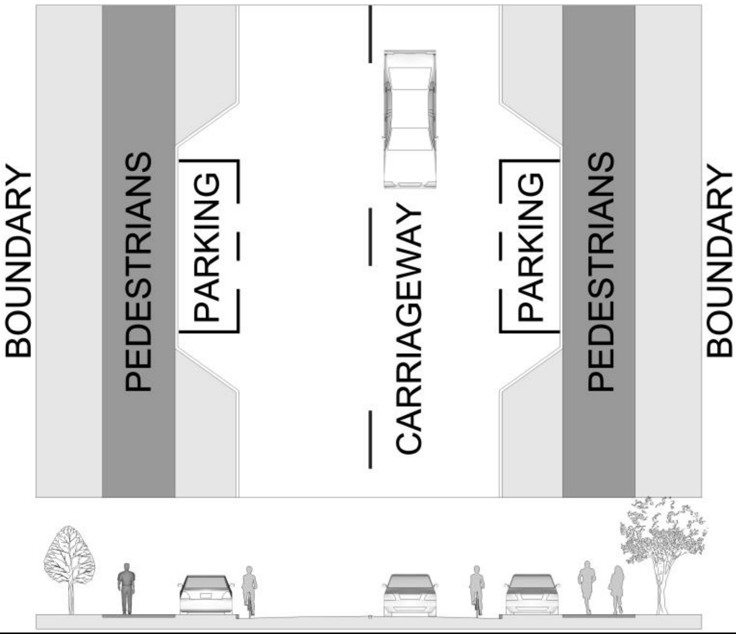


Figure E13 – Suburban, live and play, primary access to housing (up to 800 du)

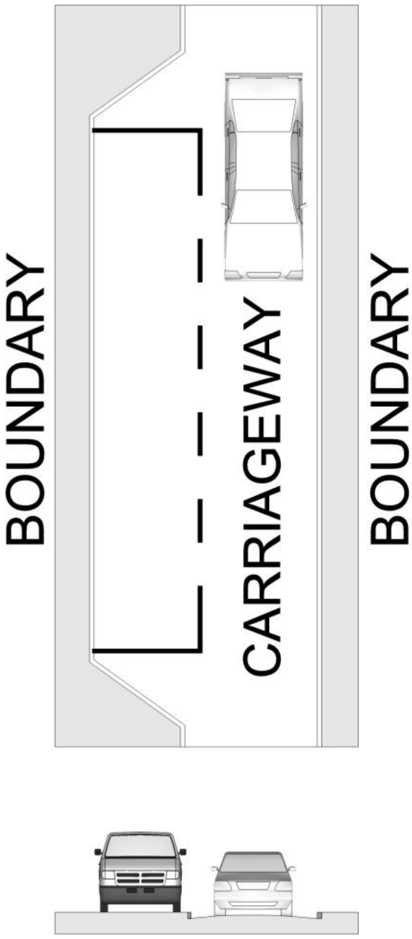


Figure E14 – Suburban, shop and trade, work and learn, side or rear service access

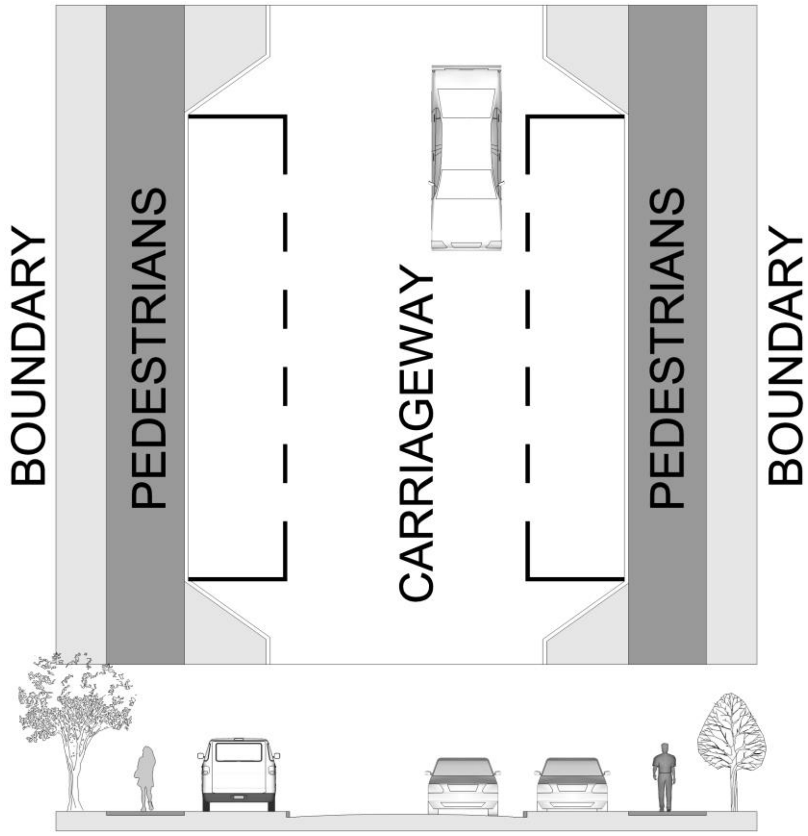


Figure E15 – Suburban, shop and trade, work and learn, access to trade, office, and education

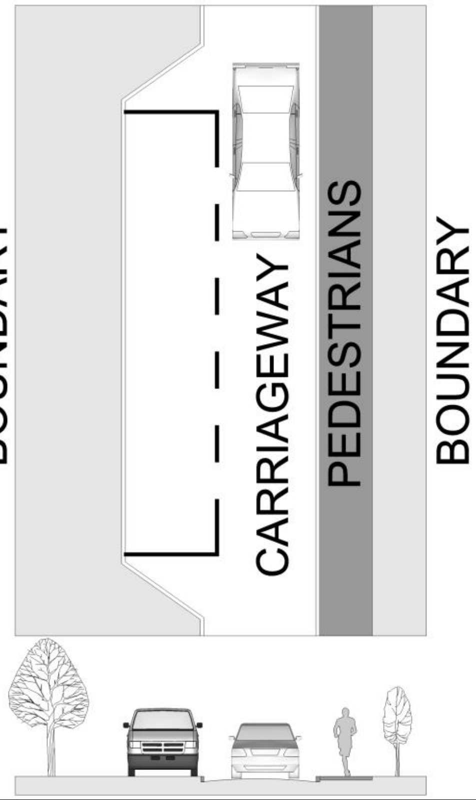


Figure E16 – Suburban, make and move, side or rear freight access

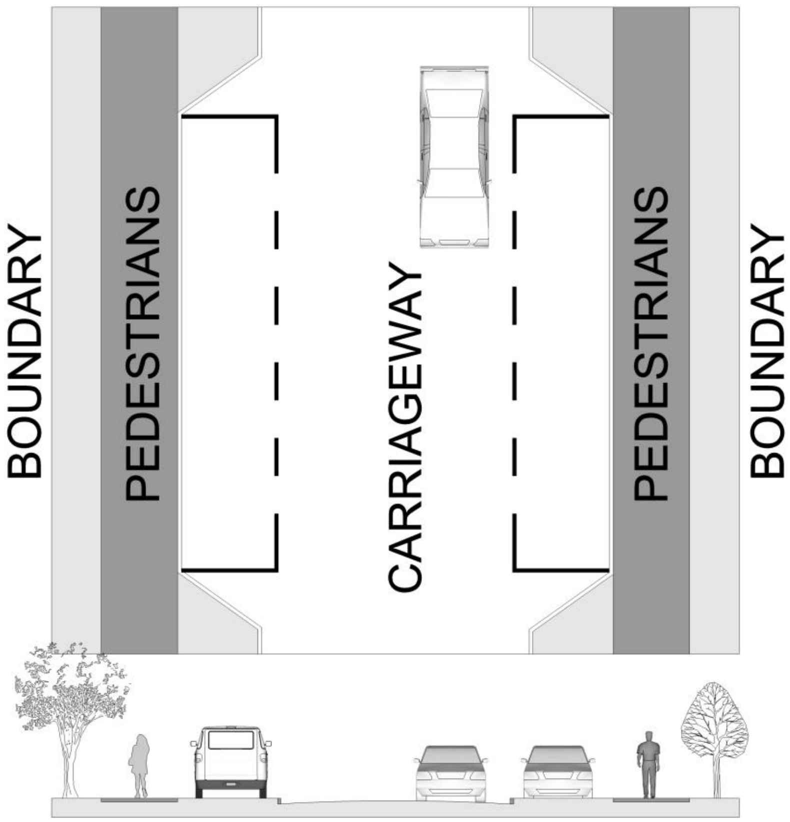


Figure E17 – Suburban, make and move, primary freight access

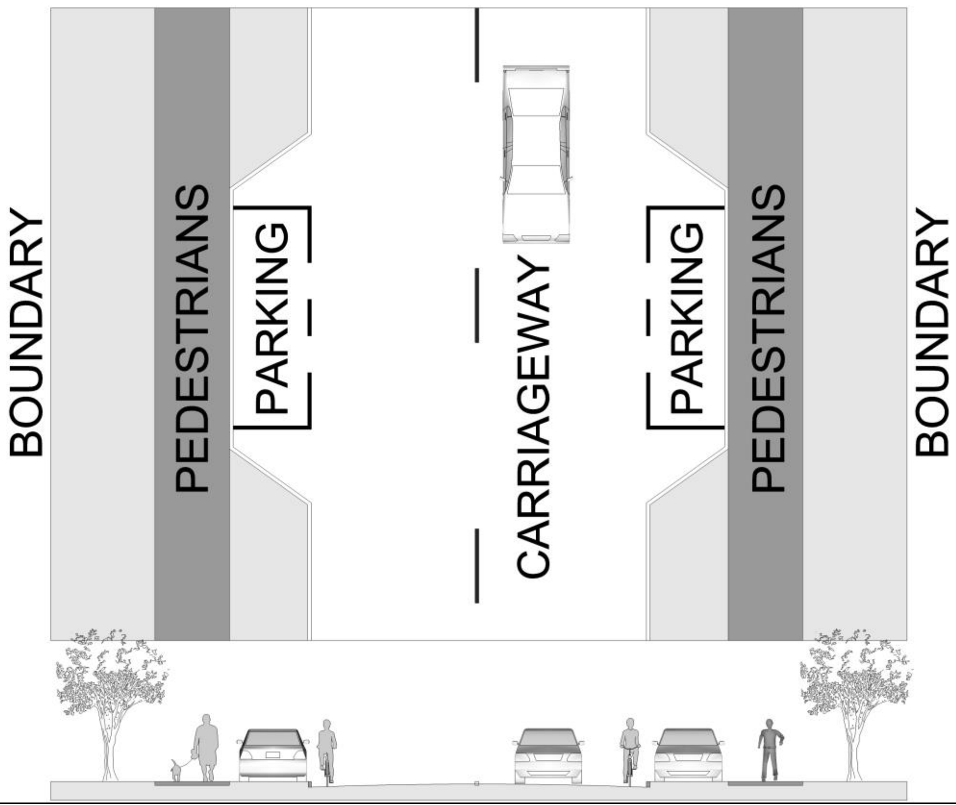


Figure E18 – Suburban, shop and trade, work and learn, make and move, all roads serving multi-purpose areas involving most or all of the indicated land uses, not specified elsewhere in table 3.2

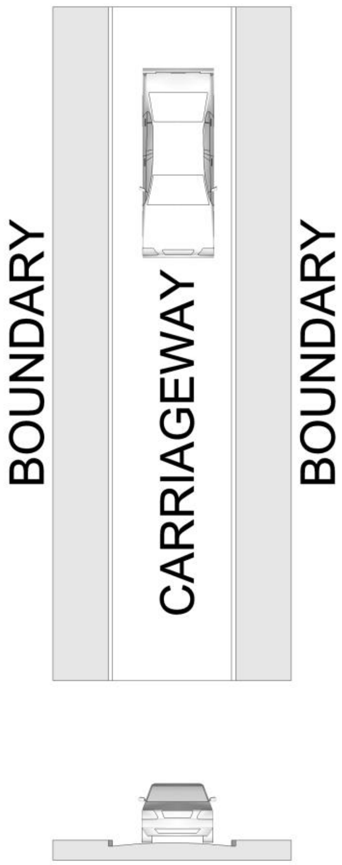


Figure E19 – Urban, live and play, access to lifestyle or clustered housing

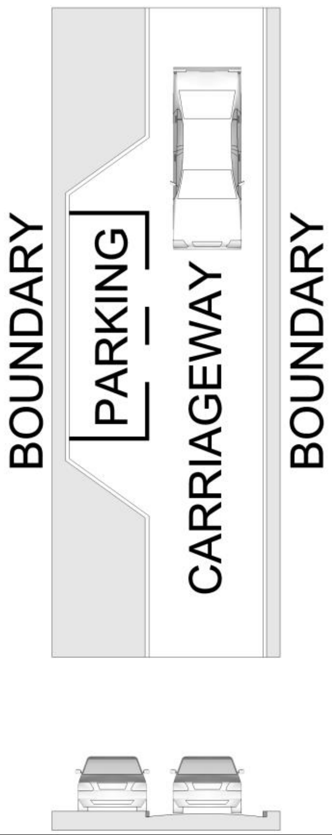


Figure E20 – Urban, live and play, side or rear service access

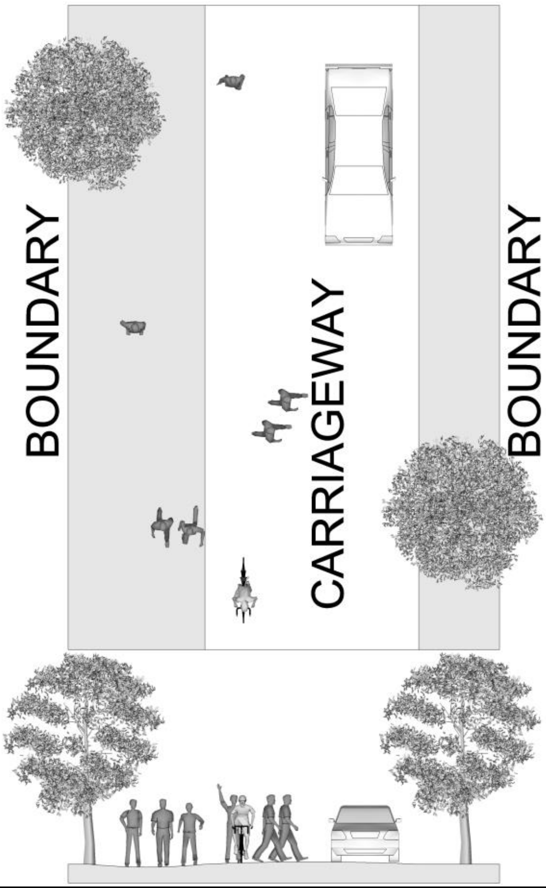


Figure E21 – Urban, live and play, access to houses/townhouses

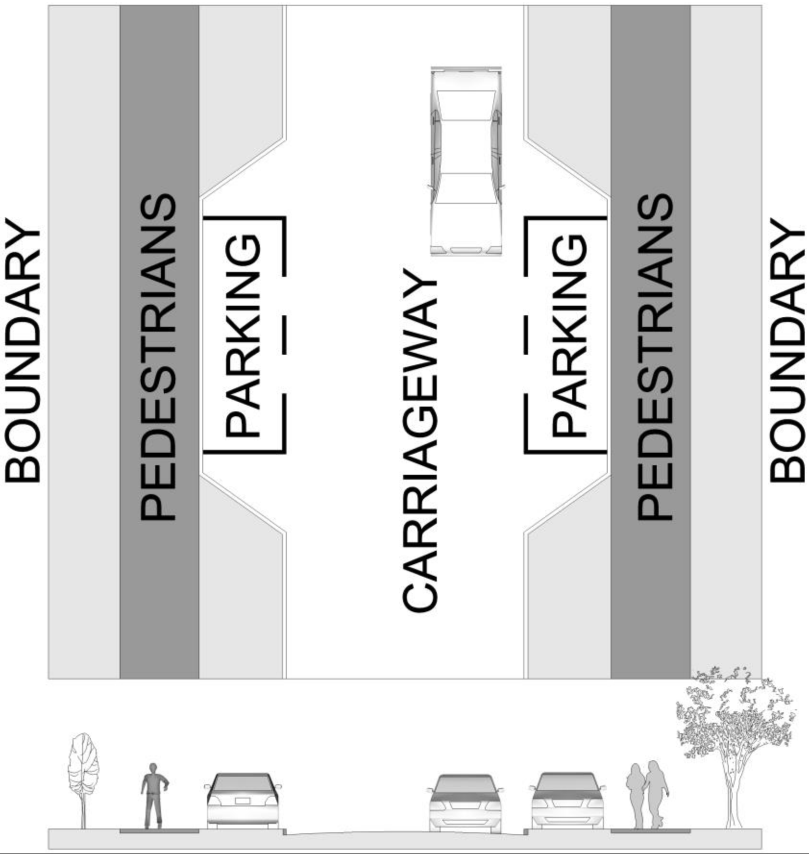


Figure E22 – Urban, live and play, primary access to housing

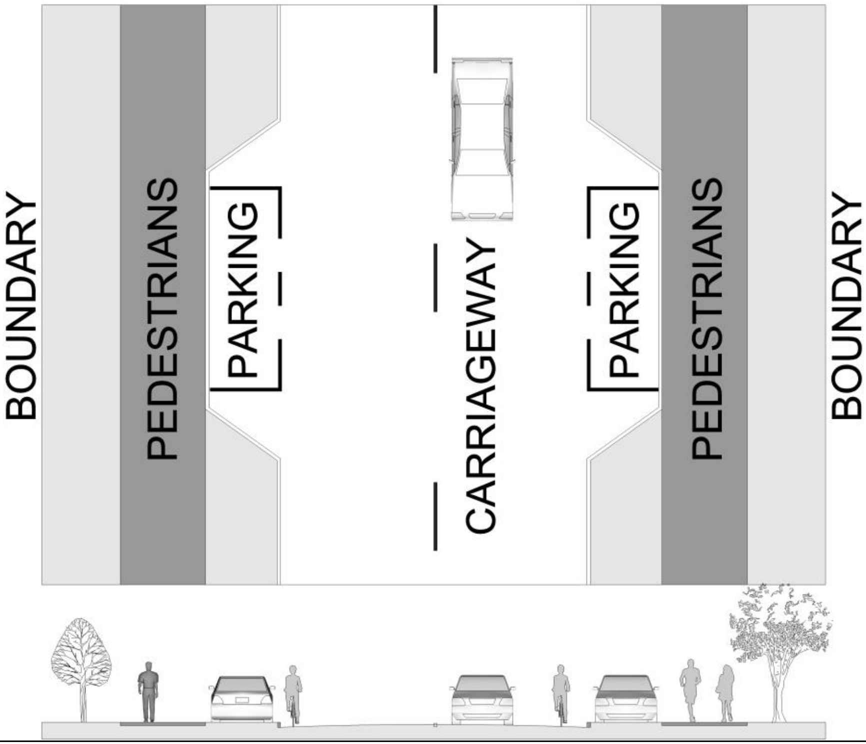


Figure E23 – Urban, live and play, all other land use activity types within this area type not specified elsewhere in table 3.2

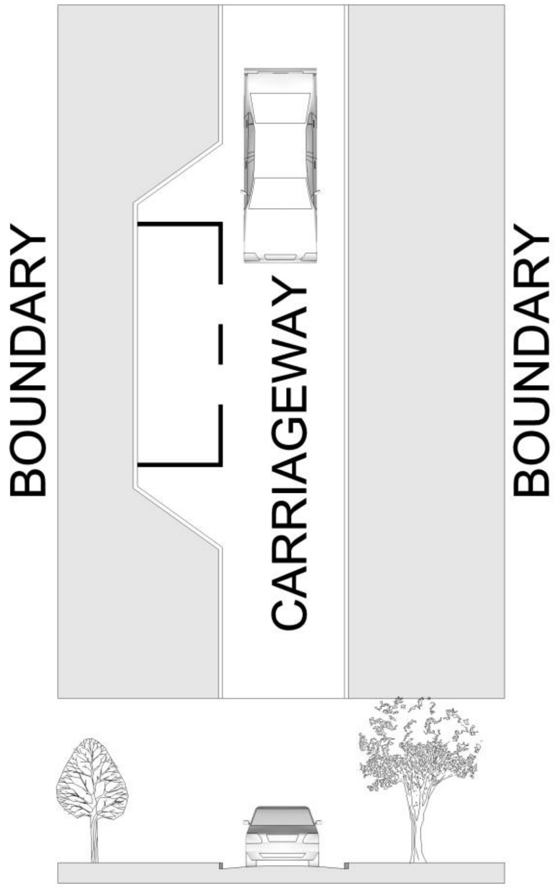


Figure E24 – Urban, shop and trade, side or rear service access

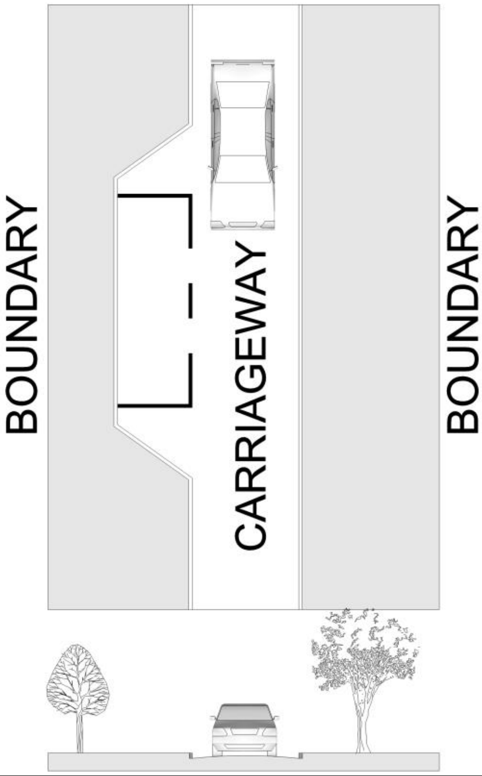


Figure E25 – Urban, shop and trade, access to lots, or shop or trade units

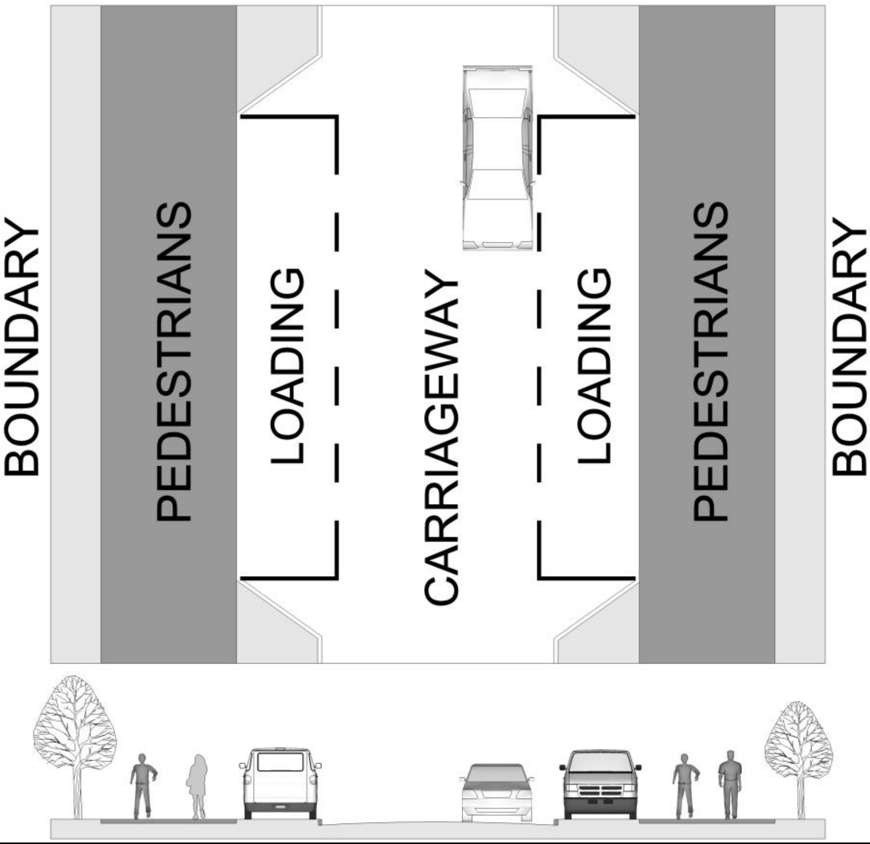


Figure E26 – Urban, shop and trade, primary access to trade

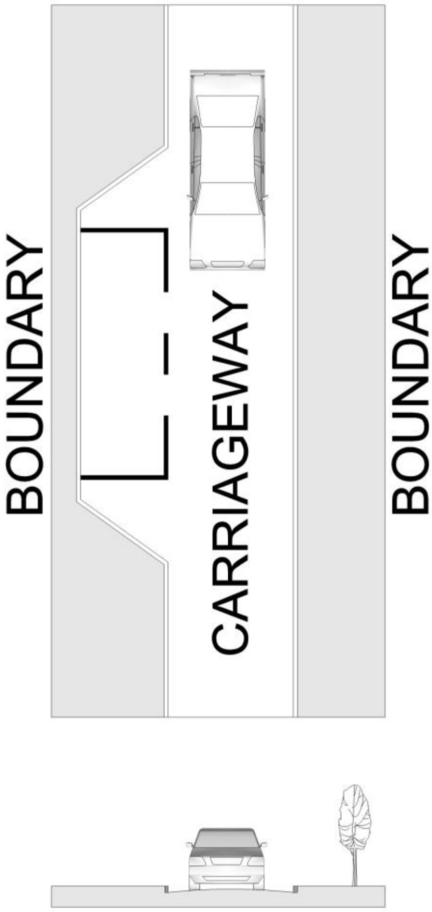


Figure E27 – Urban, work and learn, side or rear service access

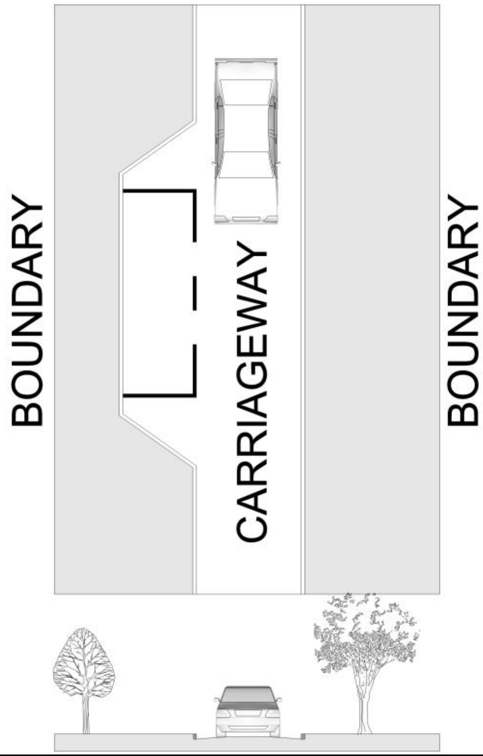


Figure E28 – Urban, work and learn, access to lots, or work or learn activities

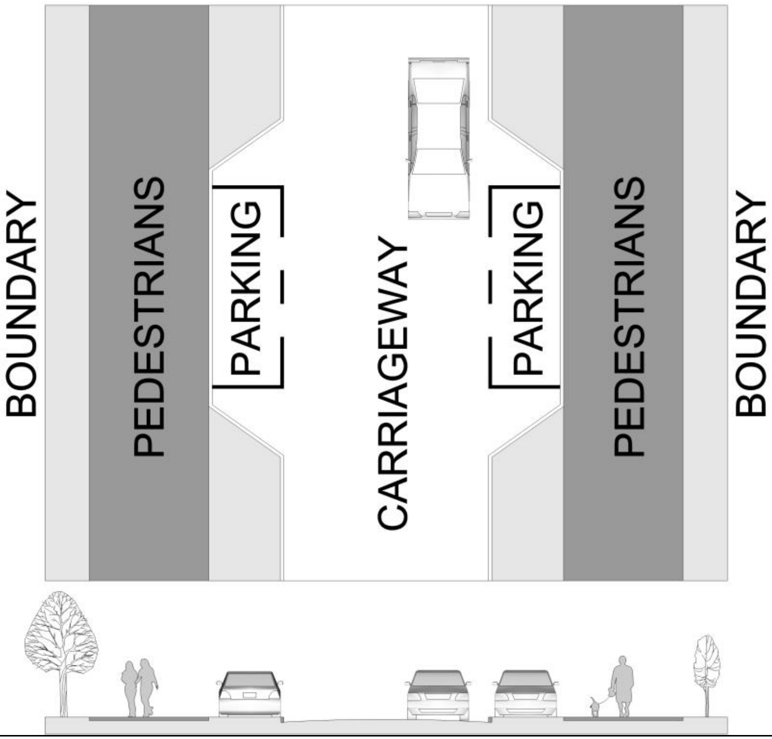


Figure E29 – Urban, work and learn, primary access to office and education

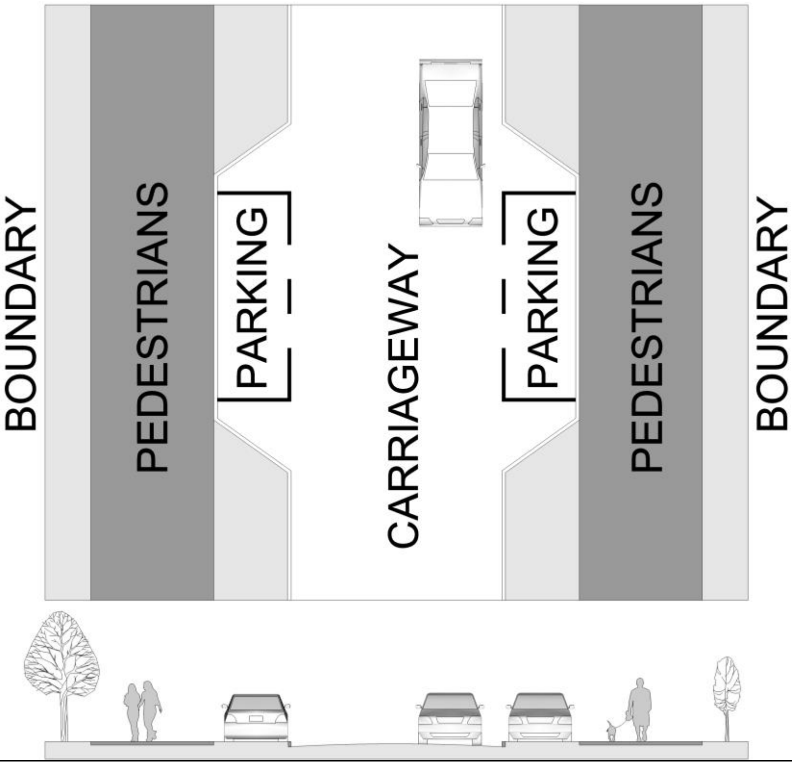


Figure E30 – Urban, mixed use, multiple user access

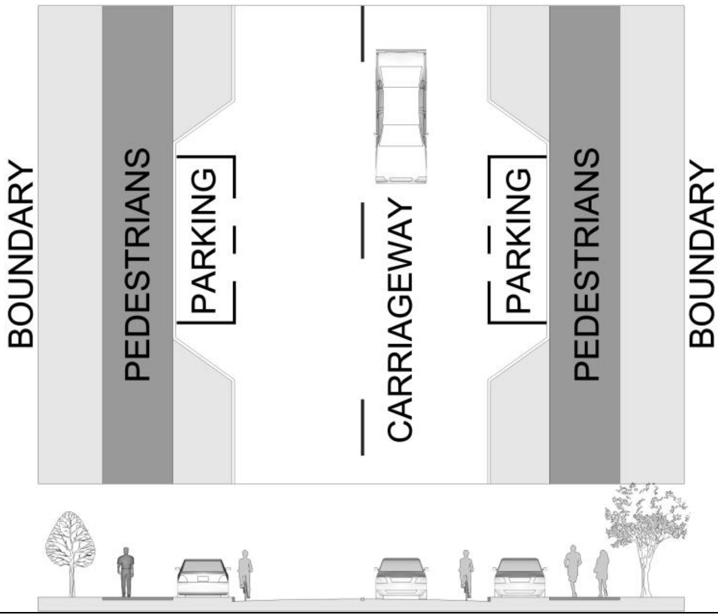


Figure E31 – Urban, mixed use, neighbourhood centres (and all other areas serving multiple land uses not listed elsewhere in table 3.2)

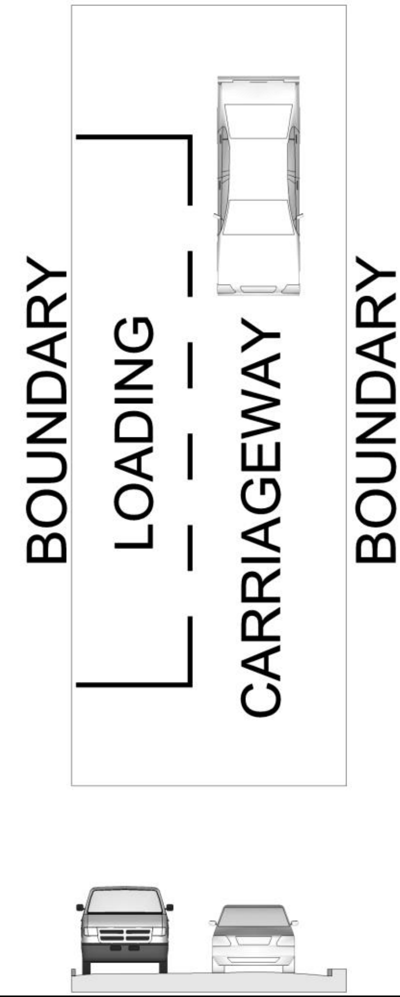


Figure E32 – Centre, mixed use, side or rear service access

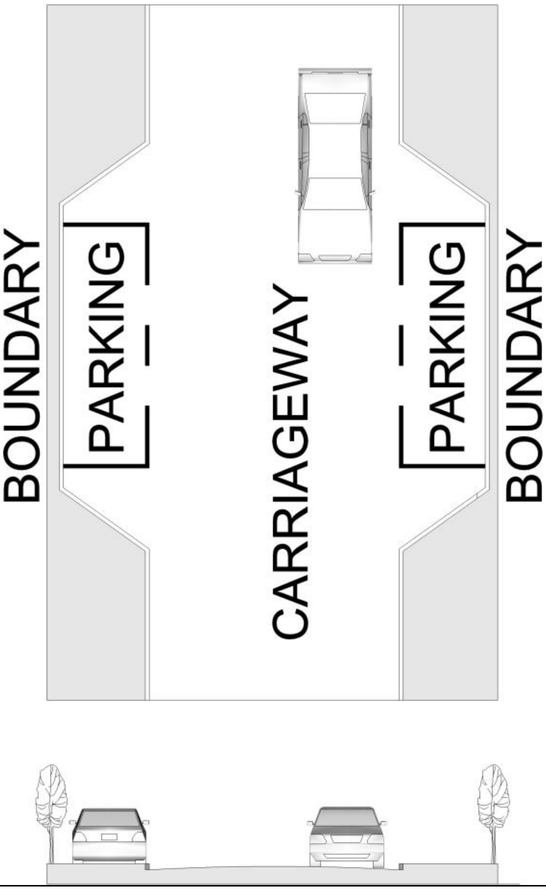


Figure E33 – Centre, mixed use, access to lots or mixed use activities

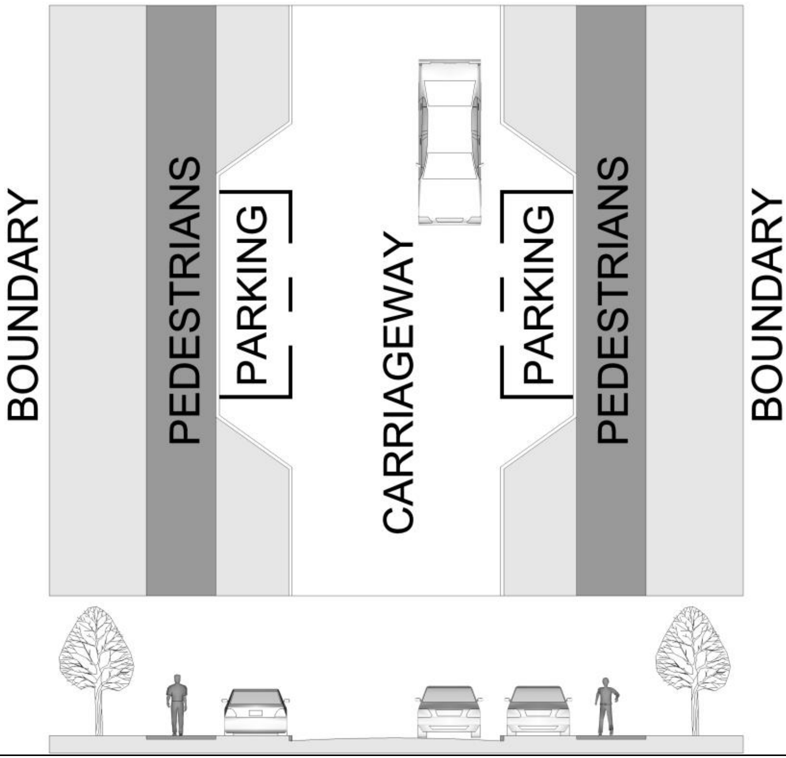


Figure E34 – Centre, mixed use, primary access and local movement

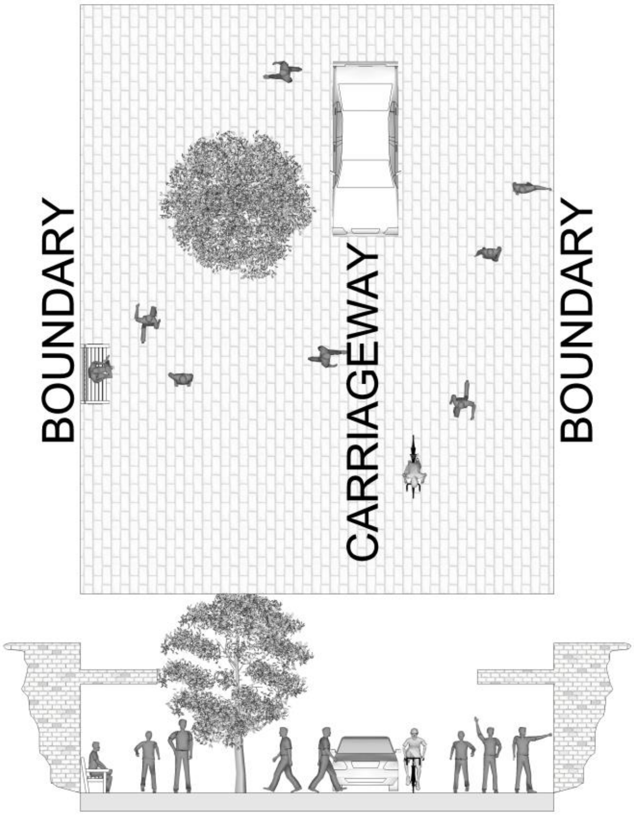


Figure E35 – Centre, mixed use, shared spaces, accessway, mall, and community reserve

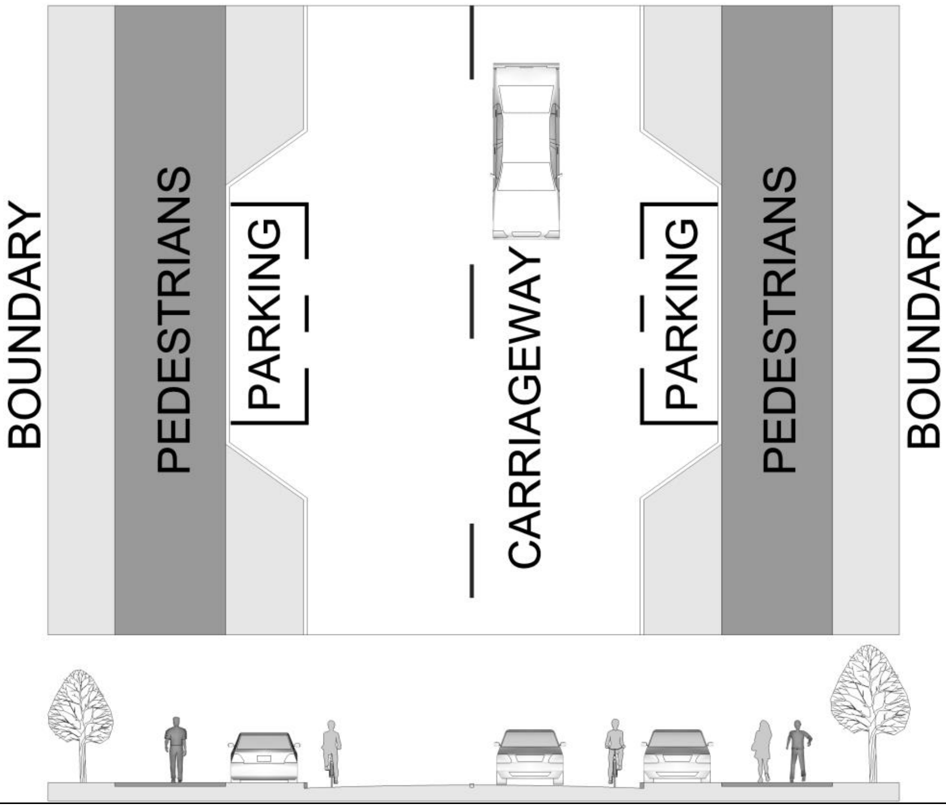
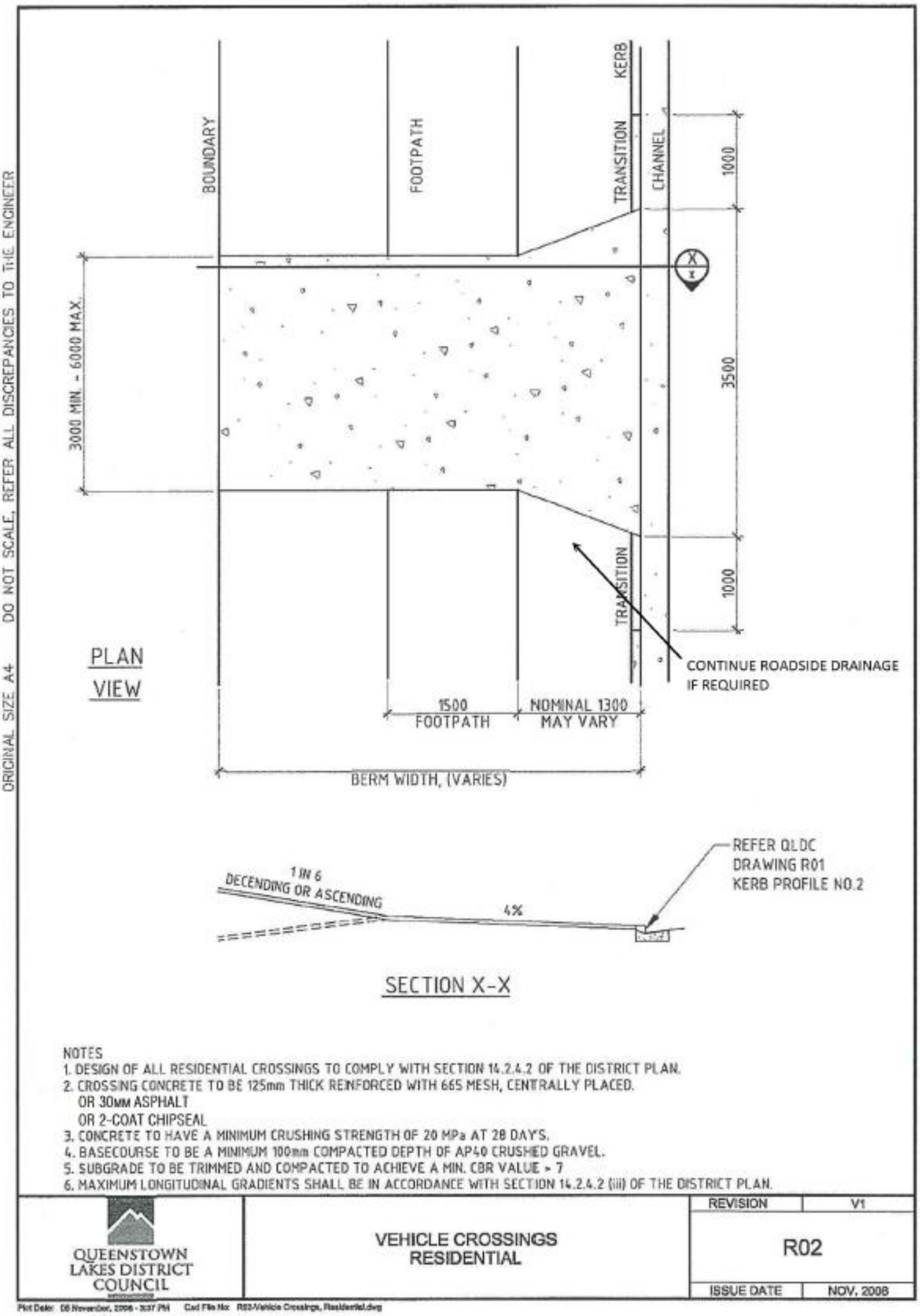
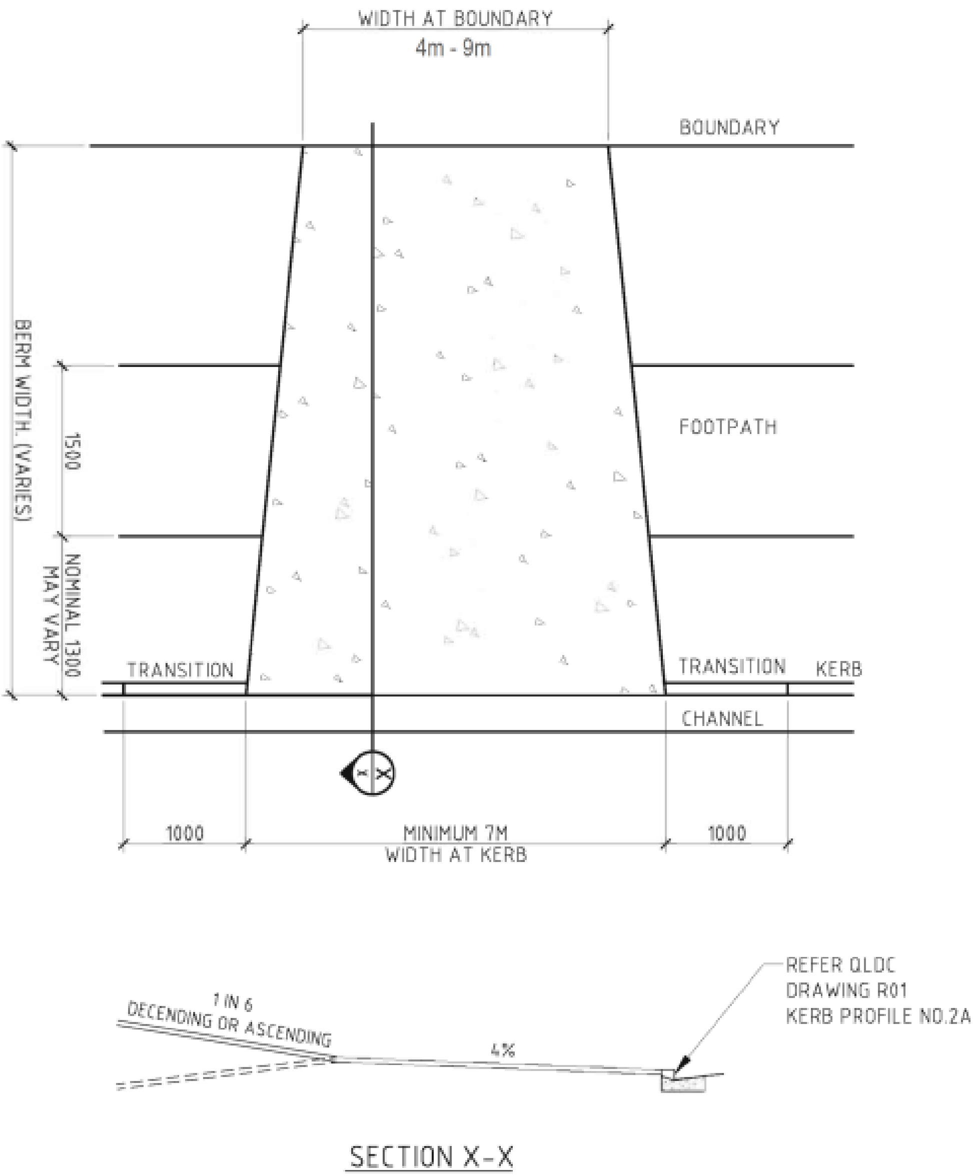


Figure E36 – Centre, mixed use, urban street

Appendix F – Vehicle Crossings



ORIGINAL SIZE A4 DO NOT SCALE. REFER ALL DISCREPANCIES TO THE ENGINEER

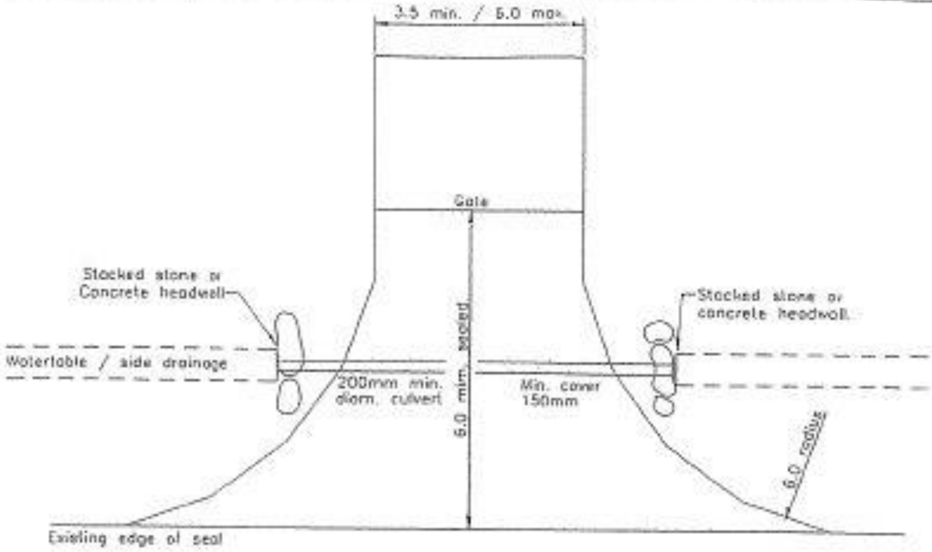


NOTES

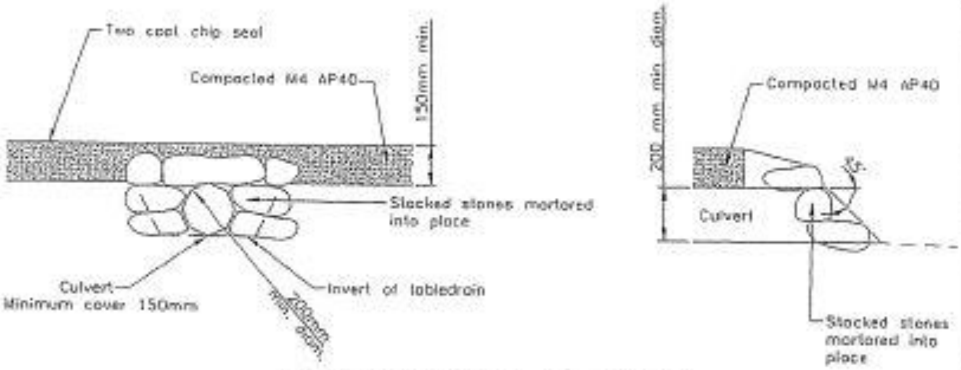
1. THE CONCRETE SHALL BE 150mm THICK AND REINFORCED WITH 665 MESH, CENTRALLY PLACED.
2. THE CONCRETE SHALL HAVE A MINIMUM CRUSHING STRENGTH OF 20 MPa AT 28 DAYS AND SHALL COMPLY WITH NZS 3124.
3. CHANNEL CROSSING TO BE HEAVY DUTY, REINFORCED WITH 3 D12 BARS.
4. SUB-GRADE TO BE TRIMMED AND COMPACTED TO ACHIEVE A MIN. CBR VALUE OF > 7
5. DESIGN OF ALL COMMERCIAL CROSSINGS TO COMPLY WITH SECTION 14.2.4.2 OF THE DISTRICT PLAN.
6. MAXIMUM LONGITUDINAL GRADIENTS SHALL BE IN ACCORDANCE WITH SECTION 14.2.4.2 (iii) OF THE DISTRICT PLAN.

QUEENSTOWN LAKES DISTRICT COUNCIL	VEHICLE CROSSING COMMERCIAL/INDUSTRIAL	REVISION	V1
		R03	
		ISSUE DATE	NOV. 2008

Plot Date: 06 November, 2008 - 3:38 PM Cad File No: R03-Vehicle Crossings, Commercial_Industrial.dwg



DIAG. 2 - PRIVATE ACCESS - PLAN



HEADWALL DETAIL

NOTES:

1. If the access is from an unsealed road then it need not be sealed.
2. Construction to be of M4 AP40 gravel, at least 150mm deep.
3. Where the access intercepts existing side drainage / water table, a 200mm min. diam (or min. diam of upstream culvert, whichever is the greater) culvert is to be installed. Pipe to be heavy PVC or conc. with appropriate bedding. If 150mm cover cannot be achieved then unreinforced conc. protection shall be provided.
4. For dimensions of Private Access (frequent use by heavy vehicles) (Diag. 3) or Commercial Access (Diag. 4) see Appendix 7 of the Council's District Plan.
5. Maximum grade of batters is 1V : 3H

QUEENSTOWN LAKES DISTRICT COUNCIL	RURAL ROAD VEHICLE CROSSING	SEPT 2003 Not To Scale
		Fig.3