DEVELOPMENT CODE

June 2009
Updated January 2010

PAPAKURA DISTRICT COUNCIL

DEVELOPMENT CODE

JUNE 2009

PART 1: GENERAL REQUIREMENTS AND PROCEDURES

1.1 SCOPE

This part of the code defines terminology used in the code and explains the roles and responsibilities of all parties involved in any development in Papakura District. This part of the code also provides information regarding the documentation requirements, design requirements, quality assurance documentation, completion documentation and information regarding the provision of bonds for uncompleted bonds.

1.2 GENERAL

This code of practice for subdivision and development gives a means of compliance with the objectives and performance criteria of the Papakura District Council's District Plan; which has been prepared in accordance with the provisions of Resource Management Act 1991 (the Act) and recognises the purpose and principles of the Act.

Part 1 of this code concerns matters of general application and general requirements to be observed.

Parts 2 to 9 of this code define requirements relating to particular types of services to be provided, and the means of compliance.

This code recognises that Council and other network operators will become the owners of the roading and other infrastructure that are created and vest in the Council in the subdivision process. Council and other network operators will assume responsibility for ongoing maintenance of these systems. It is therefore imperative that Council is given confidence that the systems are designed and constructed in a manner that ensures that they are fit for purpose at the time of transfer of ownership.

1.3 INTERPRETATION

1.3.1 General

Where any other standard named in this standard has been declared or endorsed in terms of the Standards Act 1988, then:

(a) Reference to the named standard shall be taken to include any current amendments declared or endorsed in terms of the Standards Act 1988; or

(b) Reference to the named standard shall be read as reference to any standard currently declared or endorsed in terms of the Standards Act 1988 as superseding the named standard, including any current amendments to the superseding standard declared or endorsed in terms of the Standards Act 1988. The word "shall" indicates a requirement that is to be adopted in order to comply with a standard or this code.

Definitions

In this Standard, unless inconsistent with the context, the following definitions shall apply:

AEP	Annual Exceedance Probability, which is the probability of exceedance of a given rainfall discharge within a period of one year
CERTIFICATION	Means providing certification and accepting responsibility that works have been constructed in accordance with approved drawings, specifications, and sound engineering practice.
CERTIFYING ENGINEER	Means the chartered engineer appointed by the developer to provide the necessary certifications with respect to design, supervision, and testing required.
CHARTERED ENGINEER	Means an engineer who is registered under the Chartered Professional Engineers of New Zealand Act 2002 who holds a current Annual Practicing Certificate.
COHESIONLESS SOIL	Means a non-plastic soil (sand, gravel) where the strength is derived primarily from interlocking forces between soil grains.
COHESIVE SOIL	Means a plastic soil (clay, silt, organic) where the strength is derived primarily from cohesion between the soil particles.
COLLECTOR ROADS	Locally preferred routes between or within areas of population or activities, generally distributing traffic between the arterial roads and the local road system.
COUNCIL OR TERRITORIAL AUTHORITY	Means Papakura District Council.
DEVELOPER	Means an individual or organization having the financial responsibility for the development project and includes the owner.
DEVELOPER'S REPRESENTATIVE	Means the person, appointed by the developer.
DEVELOPMENT	Means any works that are being undertaken as part of a subdivision and any works that are undertaken on land that is, or will in the future be in public ownership or that the public have or are likely to have access to. Also included are private ways and works that will be vested in the Council on completion.
DEVELOPMENT ENGINEER	Refer Engineer
DIAMETER	Pipe diameters refer to the internal diameter of the pipe.
DISTRICT	Means the District of the Papakura District Council.

DISTRICT ARTERIAL ROADS	Roads connecting the regional arterial routes to industrial or residential zones and can connect one area to another.
DISTRICT PLAN	Means the Papakura District Council's District Plan pursuant to the Resource Management Act 1991 and includes operative and proposed plan changes or variations once notified.
DRAINAGE	Means waste water drainage or stormwater drainage, and "drain" has a corresponding meaning.
EARTHWORKS	Means earthmoving operations, other than quarrying, carried out by any means for development purposes and includes: the disturbance of land surfaces by moving, removing, placing or replacing soil or earth; or by excavation, cutting or filling operations; contouring; road, driveway and access construction.
ENGINEER	Means the Development Engineer, his deputy or assistant or any other officer or other person appointed by the Council to control the engineering work of the District.
FOOTPATH	Means so much of any road, pedestrian accessway or public reserve as is laid out or constructed by authority of the Council primarily for pedestrians; and may include the edging, kerbing and channelling thereof.
GROUND	Is used to describe the material in the vicinity of the surface of the earth whether soil or rock.
HOUSEHOLD UNIT	Means a building or part of a building intended to be used as an independent residence and includes any apartment, townhouse, dwelling house or home unit.
DWELLING	Means a building or part thereof designed and used principally as a self-contained residence.
INDEPENDENT QUALIFIED PERSON (IQP)	Means a specialist approved by the Council and having the appropriate skills and qualification to carry out specific procedures.
LAND DRAINAGE SYSTEM	Refers to the flow of surface and ground water but concentrates mainly on peak surface discharges and their regulation under urban conditions.
LOCAL ROADS	All roads servicing residential and rural development other than District Arterial and Secondary Arterial (Collector) Roads.
LOOSE SOIL	Means cohesionless soil (for example, having a low Standard Penetration resistance, for example, of less than 10 blows per 300 mm). Also refers to uncompacted or poorly compacted fill.

LOW FLOW PATH	Refers to the path taken by runoff resulting from ground water discharge and light rainfall. The low flow path is to be kept to the minimum size consistent with ease of maintenance and may be considered to be 2% to 5% of the primary design flow.
NEIGHBOURHOOD RESERVES	Are public reserves for the local community recreation.
PEDESTRIAN ACCESSWAYS	Are paths between two roads. They do not include paths on road or reserves.
POST CONSTRUCTION SETTLEMENT	Means the settlement of the ground surface which takes place after completion of the construction of the earthworks.
PRIMARY DESIGN FLOW	Is the estimated stormwater runoff selected to provide a reasonable degree of protection to the surrounding land and buildings. In most cases this flow will be piped or contained within relatively narrow confines under public control by reserve or easement.
PRIVATE ROAD	Means any roadway, place, or arcade laid out within a district on private land by the owner thereof intended for the use of the public generally.
PRIVATE WAY	Means any way or passage whatsoever over private land within a district, the right to use which is confined or intended to be confined to certain persons or classes of person, and which is not thrown open or intended to be open to the use of the public generally and includes shared access or right of way.
REGIONAL ARTERIAL ROADS	Roads which form the principal avenues of communication for general traffic movement not catered for by motorways, expressways or rail lines. They predominantly carry through-traffic from one urban area to another.
SANITARY DRAINAGE	Has the same meaning as "sewerage drainage" as referred to in the Local Government Act 1974.
SCHEME PLAN	A plan lodged with Council pursuant to Section 88 of the Resource Management Act.
SECONDARY FLOW PATH	Refers to the path taken by runoff in excess of the primary design flow and should be capable of producing a reasonable degree of protection to the surrounding buildings (normally a 1% AEP flood for commercial, industrial and habitable residential floor levels). A freeboard above the secondary flow level is normally considered advisable when determining allowable floor levels. This is to cater for inaccuracies in flow estimation methods and for possible failure of the primary system.
SOFT SOIL	Means cohesive soil having a low shear strength (for example, less than 25kPa).

SOIL	Means the heterogeneous aggregation of particles comprising either peat, clays, silts, sands, gravels, crushed and re-oriented rock fragments, or a mixture of any of the above. The term excludes rock that is intact rock masses whether highly jointed or not.
SOILS ENGINEER	Means a person who is currently entitled to practice as a registered engineer and has experience in soils engineering acceptable to the Engineer; or such other person as the Engineer may specifically approve as being competent.
GEOTECHNICAL ENGINEER	Means a Chartered Professional Engineer (CPEng) or an engineering geologist with recognized qualifications and experience in geotechnical engineering, and experience related to the development.
STABLE GROUND	Means ground existing in a state which is unlikely to settle, slip, erode or otherwise move to the detriment of superimposed buildings, services, roads or property generally.
STRATEGIC ROADS	Roads, motorways and rail lines which form part of a network of strategic importance nationally, having the highest standards with access control where necessary.
SURVEY PLAN	Means a survey plan of a subdivision in terms of Section 223 of the Resource Management Act 1991 or Section 305 of the Local Government Act 1974 being a plan of a subdivision in form for deposit under the Land Transfer Act 1952 or with the Registrar of Deeds, and includes the title plan under the Survey Regulations 1972.
WALKWAYS	Are all footpaths on reserves and include pedestrian accessways.

DEVELOPER'S REPRESENTATIVE

The developer shall appoint a representative or representatives to undertake the responsibilities of:

(a) Design of the development, arranging and obtaining necessary geotechnical investigation and reports, including preparation of and obtaining the approval of engineering documents by Council;

(b) Supervision of the works;

(c) Certification upon completion that the works have been carried out in accordance with the approved documents and sound engineering practice.

(d) Provide necessary certification to Council to obtain S224c Certificate and acceptance of services to vest in Council.

The developer's representative shall be a Chartered Professional Engineer or Licensed Cadastral Surveyor or an Engineer suitably experienced and approved by Councils Development Control Manager.
Geotechnical investigations, and completion and site stability reports shall be prepared by a Chartered Professional Engineer experienced in geotechnical engineering and who has professional indemnity insurance cover.

1.4 PROCEDURE FOR APPROVAL OF THE DEVELOPMENT AND FOR ITS DESIGN AND CONSTRUCTION

1.4.1 Documents to be Submitted for Approval

Resource consent/subdivision consent is to be obtained prior to submission of engineering plans for approval. It is expected the Developers Representative will ensure the engineering plans are in accordance with the requirements of this code, other applicable standards and good engineering practice prior to submission to Council. And, shall ensure an internal peer review, or office quality assurance measures are carried out prior to submission of plans.

As a condition of granting resource consent for the development, the Council will require engineering documents to be submitted. These documents shall contain sufficient engineering detail to determine that the land is suitable for the proposed use. The documents shall show that adequate provision can and is intended to be made for services such as roads, vehicular access, stormwater drainage, water supply, sewage disposal, power, telephone, and gas reticulations. Council will then evaluate the proposals and set required conditions to be met.

Prior to the lodgement of engineering documents for approval the developers engineer shall meet with the Councils Development Engineer to discuss the proposal and potential issues. The developers engineer is to first ensure the plans are in accordance with the conditions of Resource consent. If the application is not fully complying with the Code the developers engineer is to highlight the areas and provide an explanation.

Council has a dispute resolution process to cover the situation if agreement cannot be reached on engineering design issues. This process can be triggered by the developer.

To satisfy the scheme plan conditions two sets of fully detailed engineering documents suitable for construction purposes shall initially be submitted to Council for approval. These documents shall include:

(a) Engineering drawings, specifications and calculations, covering the following sections of the work to be carried out:

- Earthworks (including silt control plans)
- Roading and site access
- Street Lighting
- Stormwater and Waste water Drainage (including catchment plans)
- Water supply and other services
- Landscaping plans including any proposed planting in roads and reserves and details of any playgrounds.

A full Integrated Transport Assessment (ITA) is to be submitted to Council for consideration for all subdivision creating over 100 lots or development over 1,000m^2 in building area or as may be required by Council.

Please note the engineering drawings, specifications and calculations shall be complete and detailed and in accordance with the recognised design standards. The street lighting for example, shall be sufficiently detailed providing:

- *Plans showing the proposed street light location including offset from the face of the kerb to the face of the pole.*
- *Light pole details including mounting height, outreach, country of origin, coating system and coating system warranty.*
- *Luminaire/lantern details including type, IP rating, country of origin, lamp type/ wattage and the cost of the luminaire, type of coating system and coating system warranty.*
- *Confirmation that the luminaire is fully compliant with AS/NZS 1158 and that spare parts will be available for a minimum of 10 years.*
- *Photometric data for the proposed luminaries and lamps.*
- *Copy of the lighting software report detailing values of the light technical parameters obtained for each area of road element involved. Isolux plots will be required for roundabouts and other traffic management devices.*
- *Details of the name and source of the programme used to generate the design.*
- *Maintenance factors assumed in calculations and maintenance schedule.*

(b) Other reports and documents as considered necessary by the Council (such reports may be required prior to subdivisional consent pursuant to Section 92 of the Resource Management Act 1991 and the District Plan). Documents that may be required by Council include:

- Integrated transport assessment.
- Scheme Plan showing all existing site information and services, and subdivision layout identifying roads, reserves and lots.
- Legal description of land being developed and identification of notes on titles, easements etc.
- Copy of the current 'Certificate of Title'.
- Geotechnical Engineer's report on the suitability of the land for development.
- Environmental impact report.
- Assessment of serviceability of each lot with waste water and stormwater disposal, water supply (domestic and fire), power, telecommunications, vehicle and pedestrian access.
- Assessment of overland flows from upstream catchments.
- Assessment of secondary flowpaths for a 100 year event.
- Copy of any previous relevant consents.
- Records of consultation with other units of Council, including United Water (U.W.I.)

- Records of consultation with other affected parties.
- Report on the selection of road names recommended and complying with the Councils Road naming policy.

Note: Council reserves the right to require peer review of reports and completion certificates where council has no relevant expert or staff to review the information or where there is, in Council opinion, needed for an independent review. The cost of the peer review will be at the developer's expense.

1.4.2 Draughting Standards and Drawings

Drawings
All drawings produced for any development in Papakura District shall be in accordance with NZS 1100 and shall be produced using an electronic medium compatible with Council's computer system. All line types, thicknesses and weights shall be selected so that the drawings can be easily read when printed and copied at A3 size. The following electronic draughting mediums are currently considered compatible with Council's computer system.

Plan Scales
The following scales shall be used:

- Plans: 1 to 500 or 1 to 250
- Longitudinal Sections:
  - horizontal 1 to 500
  - vertical 1 to 100
- Cross Sections: 1 to 100
- Details: As required

Datum
All reduced levels shall be in terms of Land Information New Zealand (LINZ) Datum Auckland Mean Sea Level 1946. Levels in these terms shall be shown on the drawings. On small jobs, if a LINZ Datum is not available within 500m of any part of the work an assumed datum may be used, at the discretion of the Engineer.

A copy of the approved set of documents shall be provided to the contractor by the developer's representative.

The Developers representative shall ensure that a copy of the approved set of documents (plans and covering letters) is available during all observations/inspections.

1.4.3 Approval of Design

Work shall not commence upon the engineering construction of the development unless:

(a) The Council has approved a scheme plan;

(b) A resource consent for the work has been approved, except when no such consent is required: and

(c) The Engineer has subsequently approved the engineering drawings, specifications and calculations for the specific work.

Councils Engineering Plan approval is valid for 12months from date of approval.

1.4.4 Notification of Contracts and Phases of Work

The Developer shall advise the Engineer, in writing, of the names and addresses of contractors to whom it is proposed to award the work, and the nature of the work to be awarded in each case.

The Certifying Engineer shall notify the Councils Development Engineer when the following phases of the work are reached and such other phases as the Certifying Engineer or Development Engineer may determine to enable Councils Development Engineer to observe the works:

- Commencement of work
- Prior to concrete works
- Prepared earthworks and subsoil drainage prior to filling
- Completed earthworks
- Commencement of drainage reticulation
- Commencement of water reticulation
- Drainage and water reticulation prior to backfilling
- Drainage and water reticulation during pressure testing
- Prior to backfilling under channel drains
- Prepared subgrade
- Completed sub-base
- Finished basecourse
- Before the commencement of road sealing

When observations/inspections are requested the works should be of good quality and in accordance with the approved drawings. The developers engineer is to have already ensured the works are to standard.

Work shall not proceed further until observation/inspection has been made. The approval of the Certifying Engineer is required after each stage prior to the commencement of the next stage.

This requirement shall also apply where different sections of the works are commenced and when work is recommenced after a substantial lapse.

1.4.5 Supervision of Work

The developer shall be responsible, both directly and through his representative, to ensure that work is carried out in accordance with the approved documents and sound civil engineering practice.

1.4.6 Connection to Existing Services

Specific approval is necessary to extend new roads beyond the site to connect into existing roads, this will require written consent from the Council Engineer and a road opening notice.

The formation, metalling, kerbing and channelling of new roads shall be extended out beyond the site to connect to existing roads and shall include the provision of stormwater disposal from the existing road. The normal cost of connecting to existing roads and services, including the alteration of the same shall be borne by the developer and shall not be a charge against the Council.

Where extensive works are required, the cost of carrying out these shall be subject of a special agreement between Council and the developer.

Connection of water, drainage and other services to existing systems will be carried out by Council's 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.

Where a drainage connection has to be carried out within private property not owned by the developer, the developer shall make the necessary arrangements and obtain a written consent to enter from the property owner prior to the work being carried out. A copy of this consent to enter shall be provided to the Engineer prior to the work commencing.

For any proposed deviation from the approved documents due to unforeseen circumstances the developer shall obtain Council's approval by submission of revised engineering documentation. A field amendment may be agreed to for minor deviations if safety issues are of concern. Any other amendment is to be in writing before commencement of amended work.

New services shall be tested by the developer under the supervision of the Certifying Engineer prior to connection.

1.4.7 Testing

Any work required to be tested by or in the presence of the Engineer shall be pre-tested and proved satisfactory to the developer's representative before an official test by the Engineer is requested. Two working days notice shall be given to Council's engineer for official testing or inspections. Note: In the event of tests proving unsatisfactory, subsequent retesting or re-inspections will result in a charge.

Test results are to be provided to Councils Development Engineer are to be final certified documents, not drafts.

1.4.8 Maintenance of Assets

The developer shall be responsible for the maintenance of all the works until they are formally accepted by the Engineer.

1. The roads, footpaths, drainage systems, street lighting, landscaping, reserve planting and any other assets vested in Council as part of a subdivision must be maintained to the standard required by this code and any applicable Resource Consent or other subsequent Council approval for the required maintenance periods after the Section 224(c) Certificate or the Title has been issued.
2. The maintenance period shall commence from the date of issue of the 224c Certificate pursuant to the Resource Management Act 1991, or if Titles have not been issued within four (4) months of the Section 224c Certificate date of issue then the maintenance period will commence from the Title issuing date.
3. The maintenance period shall be six (6) months for roads, including street lights and footpaths, stormwater and sewerage drainage pipe systems and water supply.

4. The maintenance period shall be 24 months for street trees, reserves and landscaping and stormwater quality ponds. Reference should also be made to the specific requirements of the Parks and Reserves Section and the Stormwater Quality Ponds part of the Stormwater Section.

5. On completion of the maintenance period the applicant needs to complete the following requirements:
   - Written confirmation from the Certifying Engineer that the assets have been maintained and are in good condition.
   - Prior to the expiry of the maintenance period the subdivider shall arrange for all berms and reserves on the subdivision to be mown, road carriageway swept and all catchpits cleaned out.
   - Complete a CCTV video inspection of the stormwater pipelines within one (1) month of requesting for the release of the bond, and provide Council with the CCTV video inspection reports and inspection DVD's for approval.
   - Complete Benkelman beam testing of the road within a month of the request for release of the bond, and provide the test results and report to the Development Engineer for approval.
   - If fault, defects, damage, or poor test results are identified, the Certifying Engineer is to provide recommendations for any necessary remedial action.
   - Arrange an inspection of the works to be carried out by the Development Engineer.
   - If the vested asset is not completed by the date stated in the Section 224(c) Certificate but is bonded as an uncompleted item, then the maintenance period shall commence from the date of the uncompleted works bond release.

6. Any faults, defects or damage to any of these works must be remedied at the consent holder's cost.

7. To ensure the performance of the vested assets, the Resource Consent holder must enter into a maintenance bond with Council. This bond must be provided prior to the issue of the Section 224(c) Certificate. The bond must either be a bank bond pursuant to Section 109 of the Resource Management Act 1991 from a registered trading bank or bond agent (to the Council's satisfaction) **or** cash.

   The Council's policy for the level of maintenance bond required for the maintenance of works is 150% of 2.5% of the total construction value of the works under maintenance to Council and a sum of money to cover the cost of CCTV inspections and Benkelman beam tests.

   Any cost incurred by the Council in preparing, checking, assessing and release of any bond shall be met by the Resource Consent holder.

8. If the Resource Consent holder fails to maintain the vested assets, the Council may undertake the works necessary to bring the assets up to the standard required by the Council and the cost of this work may be deducted from the bond. If there is a shortfall in the bond value and the final cost of the works undertaken by Council, these costs shall be recovered from the Resource Consent holder.

   In addition the cost of maintenance of any replacement works for the following 24 months will be deducted from the bond.

   Council will only accept ownership of works and services which have been designed and constructed to a standard which will impose an acceptable level of maintenance responsibility on the Council and its ratepayers.

1.4.9 Completion Documentation

Provision of documentation by the developer on completion of the development shall be in accordance with this clause or as required by the Council.

As-Built plans in accordance with Council's requirements are to be submitted by the developer. The details as constructed shall include, but not be limited to:

(a) Waste water Drainage Reticulation

- Manholes, lid level and invert level to LINZ Datum. Location by distance to two adjoining boundaries, and co-ordinates.
- Diameter, length of pipes laid and, material type and grade.
- House connections and distance from the centre of the downstream manhole cover, or distance to two adjoining boundaries.
- Location of the end of an extended connection.
- Rising main.
- Thrustblocks.
- Pump station including wiring diagrams, pipework details and fully itemised parts inventory and operating manuals.
- Siphon
- Pipes encased or protected.
- Pipes, manholes and pump stations removed or abandoned.

(b) Stormwater Drainage Reticulation:

- Manholes, lid level and invert level to LINZ Datum. Location by distance to two adjoining boundaries, and co-ordinates
- Inlet and Outfall structures, invert levels to LINZ Datum, distance to two adjoining boundaries.
- Diameter, length of pipes laid and, material type.
- Open water table and direction of flow.
- Catchpits.
- Subsoil drains including discharge points.
- House connections and distance from downstream manhole, or distance to two adjoining boundaries.
- Location of the end of an extended connection.
- Pipes and manholes removed or abandoned.
- Driveway pipe crossings.
- Dish drain half pipe.
- Pipes encased or protected.
- Scour protection.
- Stormwater detention ponds.
- Open channels including typical cross-section.
- Secondary overland flow paths including flood levels to LINZ Datum.

(c) Water Reticulation:

- Diameter and material type of pipes laid.
- Distance from boundary of water main.
- Depth of line.(if non-standard)
- Valves (noted for type), hydrant Tees, Branches, and Blank Caps. Location by distance to two adjoining boundaries and co-ordinates.
- Pump stations including wiring diagrams, pipework details and fully itemised parts inventory and operating manuals.

- Bores (as for pump stations)
- Rising mains.
- Thermal pipes.
- House connection and distance to nearest side boundary.

(d) Earthworks:

- Extent of fill.
- Depth of fill in the form of depth contours.
- Subsoil drains including discharge points.
- Buried retaining walls.
- Nature of fill (i.e. compacted etc)

(e) Ducts:

- Location and size of ducts installed for power, telephone, gas, or other services.

(f) Roading:

- Kerb and channel.
- Pavement type, materials and layer thicknesses (including details of any special subgrade or basecourse treatments).
- Footpath.
- Catchpits.
- Retaining walls and materials.
- Median islands.
- Extent of formation.
- Subsoil drains including discharge points.
- Extent of seal.
- Extent and depth of any undercutting.
- Road lighting.
- Edges of formation.
- Driveway pipe crossings.
- Open water table and direction of flow.

(g) As-Built plans are to be submitted showing the following standard items:

- North point.
- Legal boundaries and legal descriptions of lots.
- Road names.
- Bench marks.
- Existing installations to be identified clearly from new work.
- Schedules of Co-ordinates
- Schedules of Service connections.

As-Built plans shall be presented at a scale of 1 to 500 and shall include on each sheet at least two co-ordinate points on the NZTM NZGD 2000.

The Council's list of acceptable datums (in order of preference) are:

1. NZTM NZGD 2000
2. Mt Eden Circuit
3. NZ Map Grid
4. NZ Mt Eden Local Circuit

As-Built plans shall have been submitted to and received the approval of the Engineer prior to the issue a Completion Certificate under Sections 224(c) or 222(1) respectfully of the Resource Management Act 1991.
Two sets of the engineering plans and an engineering specification shall be submitted with all relevant calculations for catchments, pipeflows, structural and pavement designs and any other relevant documents. After approval, one set of plans, suitably endorsed, will be returned to the developer.

A set of prints and one electronic disc of the As-Built plans shall be submitted.

Council's electronic recording system is ESRI which will accept information saved in either:

(a) Shapefile; or

(b) DXF (latest AutoCAD version) format/dwg.

If your system uses a different format, please check with Council prior to submitting.

Electronic As-Built Requirements are detailed in the Appendices of this code.

In addition to the above As-Built plans the developer will also be responsible for the supply and delivery of RAMM data required to update the Council's RAMM database. The developer shall engage the Council's Road Network RAMM Consultant to collect and process this data into the RAMM database. The Road Network Consultant will carry out this task in accordance with the 'Specification for RAMM Updating of Roads' included in Appendix F of this code. Additionally the developer will need to provide the Road Network RAMM Consultant with the following information:

- Pavement aggregate source.
- Sealing chip source and properties including PSV.
- Sealing record sheets.
- Undercut areas.
- Pavement depths and details.
- Construction dates.

1.4.10 Completion Tasks

Prior to the final acceptance, at the completion of the maintenance period, the developer shall have the following works carried out:

(a) Grass to be mown on berms and any reserve within the development
(b) Carriageways swept
(c) Channels and catchpits cleaned out
(d) All gardens and plantings to be mulched and free of weeds
(e) Video stormwater system.

At the completion of the defects liability period, an inspection of the development shall be carried out by the Engineer prior to acceptance. The developer shall arrange a time for the final acceptance inspection with the Engineer at least seven (7) working days in advance so that the Council's relevant maintenance contractors may be invited to attend to familiarise themselves with the new works.

Further testing of works such as road formation, drainage and water supply systems may be required to be carried out in the course of the inspection. Any section of the works that does not comply with the approved plans and specifications or approved variations must be rectified by the developer before the development will be accepted.

1.4.11 Certification on Completion

On completion of the works, and prior to the commencement of the maintenance period, the developers certifying engineer shall certify that the works have been completed in accordance with the requirements of the Papakura District Council District Plan, Papakura District Development Code, the approved plans and sound engineering policies. The Certification shall be completed in the form attached as Appendix B to these documents.

The developer shall provide signed 'Subdivision Assets to Vest in Council' forms for all assets that are to be vested in Council. Copies of the 'Subdivision Assets to Vest in Council' forms are included in Appendix D, these forms are not an exhaustive list of assts to vest, additional pages should be used if necessary.

1.4.12 Approval of Uncompleted Work

Where in the opinion of the Engineer it is desirable, the Engineer may approve uncompleted work, subject to satisfactory bonds being arranged.

1.5 BONDS FOR UNCOMPLETED WORKS

1.5.1 Acceptance of Bond

The Council and the owner may agree to enter into a cash bond or an irrevocable letter of credit for uncompleted work. Council are not required to accept bonds, they are only accepted at council's discretion.

The following sets out the work that needs to be completed before the Council will consider an agreement for completion of works under a cash bond.

(a)	Formation work	Completed
(b)	Kerb and Channel	Completed
(c)	Stormwater Reticulations	Completed
(d)	Carriageway construction and sealing	Completed
(e)	Water Supply	Completed
(f)	Sanitary Drainage Reticulations	Completed
(g)	Street Light Standards	Erected
(h)	Fees and Charges	Paid

Note: The Benkelman Beam deflections of the road formation should comply with the requirements of the engineering plan approval before an agreement under bond will be considered.

1.5.2 Conditions of Accepting Construction Bonds

The Council may accept a cash bond or an irrevocable letter of credit from a bank where:

- The work cannot be completed due to weather conditions
- The work cannot be completed due to a circumstance beyond the control of the developer
- Inability to lay services due to lack of supply
- Where the Council itself cannot complete its works, thus delaying the completions by the owner.

A condition of accepting any bond is that the applicant will cover all costs associated with the bond including but not limited to: administration, processing, site inspection, project management etc.

1.5.3 Application for Bonding

Any application to enter into a bond pursuant to the issue of a completion certificate (except a bond for financial contribution), shall set out the reasons why works cannot be completed, and,

Shall be accompanied by

- Quotes from independent contractors on their company letterhead
- The date by which the work will be completed
- Subdivision reference number(s)

1.5.4 Calculation of Amount of Bond

Where any application for a construction bond has been approved, the amount of the cash bond shall be at least 50% greater than the estimate of the cost of the work. If conditions of consent require the works to be maintained the maintenance amount, (a minimum of 2.5%) of the total value of the total value of the subdivisional construction works shall be added to the bond amount.

The amount added shall depend upon the stated date by which time the applicant considers the work will be completed (to allow for price changes).

1.5.5 Period of Bond

The applicant shall give the date when the uncompleted work will be finished which should not normally exceed six months. The length of time permitted may dictate the amount of the bond. The Council may extend the period of the bond but unless there are special circumstances, not beyond two years.

Extensions of time will require a revision in the amount of the bond.

1.5.6 Condition for Construction Bonds for Works

The owner shall forward a letter to the Council accepting the following conditions:

The owner shall:

(a) Undertake to complete the bonded works within the period stipulated by the Council

(b) Maintain all works until the uncompleted works have been accepted or passed by the Council
(c) Inform any purchaser of any allotment affected by bonded works that the Council is not responsible for the uncompleted works and occupation of any dwelling erected on the allotments may not be permitted until the works are completed
(d) Give right of entry for Council staff or contractors to enter on the land to complete the work, should this be necessary.

1.5.7 Completion by Council

Where the owner fails to complete the work to the satisfaction of Council within the prescribed period, the Council may enter on the land and complete the works and recover the costs from the money held by the Council by way of cash bond or letter or credit. Once the work is completed to the satisfaction of the Council, the balance of a cash bond, if any, will be refunded.

If there is a shortfall of funds the applicant is to pay the balance to Council and the applicant is to meet all cost involved.

PART 2: EARTHWORKS AND FOUNDATIONS

2.1 SCOPE

This part of the code sets out the requirements for the carrying out of earthworks or preparation for foundations, or both, including:

(a) The excavation and filling of land to form new contours

(b) The assessment and protection of slope stability

(c) The suitability of both natural and filled ground for the founding of roads, buildings, services and other works

(d) The control of erosion and siltation during and after earthworks.

Because of the wide range of soil types, physical conditions and environmental factors applying in different areas it is not possible to lay down precise requirements which will be applicable in all situations. The criteria set out in this section will be subject in particular instances to the judgment of the Engineer, developer or Soils Engineer.

2.2 GENERAL

Refer to the Council's District Plan for matters concerning the layout of developments. The choice of final landform is dependent on many factors which may be specific to the subdivision. These include:

(a) Relation with surrounding landscape

(b) Size

(c) Roading pattern

(d) Preservation of natural and cultural features

(e) Stability

(f) Damage by flood or other natural occurrences such as erosion by sea, river, or surface water runoff.

The New Zealand Standard NZS 4431 ‘Code of Practice for Earthfill for Residential Development’ provides a means of compliance with Council's requirements for earthfills. The New Zealand Standard NZS 4402 defines and describes the methodology for all tests for fill material.

The New Zealand Standard ‘Methods of Testing Soils for Civil Engineering Purposes’ provides details and methodology for the various tests used to determine the strength of in-situ and constructed soil formations.

Attention is also drawn to the Papakura District Council Document ‘Building Roads on Peat’. This is not to be regarded as a design guide but provides some information as

to past experience on peat formations in the Papakura District. All development on peat formations will require specific design by the developer.

The operative document for earthworks in the District is TP 90, Erosion and Sediment Control. This document requires that "Guidelines for Land Disturbing Activities in the Auckland Region" be adopted by Developers. When the Proposed Regional Plan for Erosion and Sediment Control is adopted the adopted document shall be used.

The Papakura Operative District Plan requires appraisals of the stability and suitability of the land before development consent is given. Many of the requirements in this part of this code will therefore be relevant to the pre-consent stages of a development in particular the clauses covering 'site investigations' and 'planning and design'.

Earthmoving activities are subject to both Regional and District Council approvals. Resource and earthworks consents shall be obtained before commencement of site work.

2.3 TECHNICAL RESPONSIBILITIES

Where any development involves the carrying out of bulk earthworks, the assessment of slope stability, or the detailed evaluation of the suitability of natural ground for the foundations of buildings, roads, services or other works, then a Soils Engineer shall be appointed by the developer to carry out the following functions:

(a) Prior to detailed planning of any development to undertake a site inspection and such investigations of subsurface conditions as may be required to satisfy the requirements of the Papakura District Council District Plan.

(b) Before work commences review the drawings and specifications defining the earthworks proposed and submit a written report to the Engineer on foundation and stability aspects and any proposed departures from this standard.

(c) Before work commences and during construction determine the extent of further specialist Soils Engineering services required (including investigation and geological work).

(d) Before and during construction the Soils Engineer shall:

(i) determine the methods and frequency of construction control tests to be carried out
(ii) determine the reliability of the testing
(iii) evaluate the significance of test results and field inspection
(iv) assess the quality of the finished work.

(e) During construction to provide such regular and sufficient inspections and guidance to ensure that all lots are stable and suitable for their intended purpose, drainage lines are compacted, any uncompacted or unsuitable materials removed, road designs and their construction is based on appropriate soils strength assumptions and the requirements of (f) below are met.

(f) On completion to submit a statement of professional opinion as to suitability of land for building development as shown in Appendix A.

The construction quality control testing shall be carried out by a competent person under the control of the Soils Engineer.

Quality control is defined as "the operational techniques and activities that are used to fulfil requirements for quality", and shall include the provision by the Developer of testing of materials and workmanship in accordance with the project specification.

All sampling and testing shall be undertaken under the supervision of personnel who have signatory authority for such operations from International Accreditation New Zealand (IANZ), and all results shall be submitted through an IANZ Accredited Registered Laboratory. The results shall carry the IANZ marking where applicable.

The Certifying Engineer will be required to ensure compliance with the quality assurance and quality control requirements of the project as specified by the Soils Engineer. All materials sampling and testing shall be carried out under the signatory of an IANZ accredited materials testing laboratory.

2.4 SITE INVESTIGATIONS

2.4.1 Preliminary Site Evaluation

Prior to any detailed planning or design, the developer or Soils Engineer, as applicable, shall undertake a preliminary evaluation of the site to determine the likely requirements for earthworks or the need for further investigations into the suitability of foundation conditions, and the stability of the natural ground. The preliminary evaluations 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.

2.4.2 Specialist Services

Where a Soils Engineer has been appointed as required by Section 2.3, then prior to or at the time of submission of a scheme plan shall submit to Council a written report setting out the particulars of any investigations carried out including details of contours, natural features and modifications proposed thereto; and shall furnish to Council a statement of professional opinion as to the suitability of the land for the proposed development with details of any special conditions that should be imposed.

2.5 PLANNING AND DESIGN

2.5.1 Landform

The final choice of landform should represent the most desirable compromise between the factors referred to above and the preservation of natural features and the natural quality of the landscape including the retention of natural watercourses.

The choice of a suitable landform is dependent on many factors which may be specific to a particular site. In general, unnecessary earthworks should be avoided and every effort made to maintain the natural landform but considerations which may justify the carrying out of earthworks include:

(a) The minimisation of the possibility of damage to property occurring through ground movement in the form of slips, subsidence, creep, erosion or settlement and damage to the land.

(b) The minimisation of the possibility of damage to property occurring through flooding, or surface water runoff.

(c) 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.

(d) 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.

(e) The need to create suitably graded areas for neighbourhood reserves and other community facilities.

(f) The enhancement of the general environmental character of the area by softening the landscape or by artificially creating or emphasising landforms of visual significance particularly on flat sites or on areas devoid of landscape features.

2.5.2 Soil Investigations

Where appropriate the general nature and shape of the ground shall be studied and particular note taken of:

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

(b) Existing and proposed drainage conditions and the likely effects on ground water

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

(d) Performance of comparable cuts and fills (if any) in adjacent areas.

Soil data should be obtained for areas which:

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

(b) Are intended to yield material for construction of fills

(c) Are intended to be exposed as permanent batters.

Sufficient borings, probings, or open cuts shall be made to:

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

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

(c) Establish the natural ground water levels.

The soil information thus obtained shall form the basis for:

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

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

The appropriate test data in different areas shall be determined by the Soils Engineer.

2.5.3 Stability Criteria

Settlement
The most important factor in ensuring satisfactory performance of stable fills is the limiting of post-construction differential settlement. The design and construction of fills shall be such that these settlements are kept within acceptable limits.

Bearing capacity
The strength of the ground resisting general shear failure (and resulting gross deformation) under the footings of a house is a local phenomenon distinct from settlement. Fill constructed to minimise settlement in accordance with this code will have adequate shear strength.

Shrinkage and expansion
Because some clay soils are likely to undergo shrinkage and swelling when subjected to seasonal or other changes in water content, special examination of swelling and shrinkage characteristics should be made in the case of highly plastic soils. Where peat soils are present in the area of the subdivision then special provisions shall be made to limit drainage of the peat which would lead to shrinkage. Where applicable, the need for a foundation depth or design sufficient to minimise these effects, particularly for continuous brittle walls, should be noted in the completion report and statement of the Soils Engineer.

Slope stability
In most cases, it is unnecessary or impracticable to measure quantitatively the factor of safety of a slope against shear failure. Maximum slopes of cuts and fills may be determined by the Soils Engineer from experience and from observation of slopes in the vicinity which have a long-standing history of stability, are of similar height to the proposed slope and are of apparently similar geological formation. Where necessary or a precedent is not available, a special Soils Engineering investigation should be carried out by the Soils Engineer to determine acceptable limits to cut and fill slopes. In assessing slope stability account should be taken of possible future changes in ground water level or other conditions. Where a fill may be required to act under extreme conditions as a detention dam, investigation should include the ability of the fill to act as a detention dam and upstream effect of the fill.

2.5.4 Quality of Filling Material

The majority of soils, other than organic material, are potentially suitable for fillings under controlled conditions. Compaction standards for fill material are covered in the next clause of this code.

2.5.5 Compaction Standards for Fill Material

As described in NZS 4431, the standard of compaction shall be measured in terms of one of the following:

Relative compaction

That is, the ratio of the field dry density of fill to the maximum (laboratory) dry density expressed as a percentage. Unless otherwise required by the Soils Engineer, fill should be compacted to at least 95% relative compaction, in terms of the standard method of compaction.

Air voids and shear strength

Used for cohesive soils, where specific test methods and criteria should be determined by the Soils Engineer, who may, for example, require air voids to be less than 10% and shear strength to be not less than 50kPa on completion of construction.

Relative density

That is, the field dry density expressed in terms of maximum minimum densities established by laboratory test (used for cohesionless soils). The specific minimum value should be determined by the Soils Engineer who may, for example, require a minimum relative density of 80%. See NZS 4431.

Field relative compaction (field Proctor test)

This is the ratio of the density of the compacted fill material at its in situ moisture content, relative to the density of the same material at the same moisture content after standard compaction (New Zealand Standard compaction) in terms of Test 14 of NZS 4402. (This method gives a quick determination of the actual field compaction effort being applied, relative to New Zealand Standard compaction, without need for drying in the testing procedure and this may be adequate control provided the material is close to optimum moisture content.)

2.5.6 Erosion Control

Development work shall be carried out in such a manner as to restrict soil erosion by water and wind action to acceptable levels.

Before commencing any site works, adequate silt retention structures as detailed in the Auckland Regional Council Technical Publication No. 97 "Erosion and Sediment Control Guidelines for Earthworks", shall be designed to ARC Technical Publication No. 90 and constructed to the satisfaction of ARC Environment, and the Engineer. These structures shall be maintained and cleaned out as necessary until complete grass cover has been re-established over the site to the satisfaction of the Engineer. Earthworks on sites exceeding 1 hectare in area require the specific approval of ARC Environment. Such approval shall be obtained by the developer.

Two copies of the location and details of the silt retention structures, together with a copy of the ARC Environment approval if required, shall be forwarded to the Engineer prior to his giving approval for any earthworks on site.

The discharge of sediment laden runoff from earthworks must comply with the ARC Environment Proposed Regional Plan for Erosion and Sediment Control.
The diversion of natural water is only permitted for those activities listed in the Auckland Regional Council Transitional Plan. All other diversions will require a Water Permit from ARC. The obtaining of, and compliance with, the water permit will be the responsibility of the developer.

Earthworks operations shall be carried out in such a manner that a dust nuisance is not created to adjoining properties.

Stripped areas of the site shall at all times be kept to a minimum and all bare surfaces not to be bulk earthworked for a period of two months or more shall be topsoiled and grassed, or otherwise sealed.

In dry windy conditions haul roads shall be watered and in extreme conditions operations on site shall cease immediately if a dust nuisance to adjoining properties exists.

Without prejudice to the conditions of any water permit the following practices shall be adopted in the planning and design of developments involving earthworks:

(a) Large projects shall be programmed for construction in self-contained stages which can be largely completed within one earthworks season. Where possible, the upper part of a catchment should be developed first.

(b) Where possible, the permanent stormwater system shall be designed so it can be constructed at an early stage in the project and be used to collect runoff from the site during construction in conjunction with silt control measures.

(c) The specifications shall require the use of construction procedures which minimise concentration of runoff and excessive velocities, which could otherwise result in erosion.

(d) Silt retention ponds shall be constructed and maintained in all earthwork projects as required by ARC Environment.

(e) Graded 'V' drains (also called contour drains) shall be used to divert runoff water from non-construction areas past site-works, or to divert runoff from exposed areas into silt retention ponds and reduce overland flow distances on bare surfaces. Such drains should have a maximum slope of 1% and a maximum design velocity of flow of 1 m/s.

(f) Cut and fill areas shall be re-topsoiled and sown as soon as possible after earthworks and drainage works.

(g) The batter faces of cuts and fills shall be protected as soon as possible after construction by grassing, hydroseeding, tree planting, or other suitable surfacing.

(h) Existing shelter belts, wind fences and standing vegetation shall be maintained in order to reduce wind erosion.

2.5.7 Provision for Permanent Services

Where settlement is expected to occur, all service pipes installed within or under earthfilling shall be designed and constructed to ensure adequate capacity, strength and water-tightness to withstand the loads due to settlement and to prevent leakage into the fill.

Where surface water could cause erosion of batters or internal instability through soakage into the soil, open interceptor drains shall be constructed in permanent materials, benches in batter faces shall be sloped back and graded longitudinally to reduce spillage of stormwater over the batter. Water from stormwater systems shall be prevented from flowing into a fill or into natural ground near the top or sides of a fill and no stormwater soak pits shall be constructed in a fill whereby the stability of the fill might be impaired.
All drains required permanently to protect the stability of fillings or to prevent flooding and erosion shall be clearly identified as such on the As-Built drawings.

2.6 CONSTRUCTION PROCEDURES

2.6.1 Specifications

Before any earthworks are commenced, areas of cut and fill shall be clearly defined. Where necessary, sufficient fencing or barriers shall be provided around trees or other features to be protected. All site activities including clearing, storage, cutting and filling must be kept away from the root zone of trees (best defined as the extent of the canopy plus 2m). Adequate provision shall also be made for the control of erosion, surface water runoff and siltation.

Specifications including the following are to be prepared to control the earthwork construction as follows:

(a) All rubbish, vegetation and debris shall be removed from earthworks areas prior to the commencement of topsoil stripping. Areas on which fill is to be placed, or from which cut is to be removed and haul roads shall be stripped of all topsoil and such unsuitable soft or organic material as determined by the Soils Engineer. Special care shall be taken to ensure the organic materials and areas of old uncompacted filling are not overlooked through being overlaid by other soils.

(b) Stripping shall be carried out as a specific operation with areas being stripped in large enough increments to ensure that there is an adequate margin of stripped ground beyond any current cutting or filling operation. Particular care shall be taken to ensure that overspill is not left in an uncompacted state anywhere on the site, when constructing temporary haul roads.

(c) All stripped material shall be deposited in temporary stockpiles or permanent dumps, in locations where there is no possibility of the material being unintentionally covered by, or incorporated into, structural fills.

(d) Where a fill abuts against sloping ground, benches shall be cut into the ground to prevent the development of a continuous surface of low shear strength.

(e) Pervious drains or similar subsoil seepage control systems shall be installed (as necessary) to lead seepage away from all springs and potential areas of ground water under or adjacent to fills in order to -

- Prevent saturation of the fill before construction of the fill is complete;
- Prevent internal erosion (piping); and
- Prevent internal ground water pressures which would detrimentally reduce shear strengths.

(f) Subsoil drains shall discharge via flexible jointed pipes to an outlet approved by the Engineer, preferably a stable watercourse or a piped stormwater system. The position of all subsoil drains shall be recorded on the As-Built plan.

(g) The stripped ground surface shall be prepared and then inspected by the Soils Engineer before any fill is placed thereon.

2.6.2 Fill Construction

The quality of fill material and required control testing shall be determined and specified before the placing of fill commences. Fill shall be placed in a systematic and uniform manner with near horizontal layers of uniform thickness (less than 225 mm) of material being deposited and compacted progressively across the fill area.

Before any loose layer of fill is compacted, the water content shall be suitable for the compaction required and as uniform as possible. Any compacted layer which has deteriorated after an interruption in the earthmoving operation, shall be rectified before further material is placed over it.

Fill batter faces shall be compacted as a separate operation or alternatively, overfilled and cut back.

Where testing shows the compaction achieved in the field to be below the specified minimum, all material represented by the test shall be further compacted or removed as necessary.

2.6.3 Temporary Drainage and Erosion Control

During the construction period, measures shall be taken to prevent excessive water logging of surface materials yet to be to be excavated or compacted or both and to prevent fill material from being eroded and redeposited at lower levels. Such measures shall include:

(a) The surface of fills and cuts shall be graded to prevent ponding.

(b) Temporary drains shall be constructed at the toe of steep slopes to intercept surface runoff and to lead drainage away to a stable watercourse or piped stormwater system.

(c) Surface water shall be prevented from discharging over batter faces by drains formed to intercept surface runoff and discharge via stable channels or pipes, preferably into stable watercourses or piped stormwater systems.

(d) The upper surface of fills shall be compacted with rubber tyred or smooth wheeled plant when rain is impending, or when the site is to be left unattended.

(e) The completed battered surfaces of fills shall be compacted with sheepsfoot or similar non-smooth compaction plant to reduce runoff velocities.

(f) Silt traps and retention ponds shall be constructed where they are feasible and necessary. These shall be cleaned out, as required to ensure that adequate silt storage is maintained.

(g) Temporary barriers or fences choked with brush, sacking or the like, shall be used to reduce flow velocities and to trap silt.

(h) Sections of natural ground shall be left unstripped to act as grass (or other vegetation) filters for runoff from adjacent areas.

(i) All earthwork areas shall be re-topsoiled and grassed or hydroseeded as soon as possible after completion of the earthworks and drainage works.

2.6.4 Inspection and Quality Control

The Soils Engineer shall provide an adequate level of inspection and testing, in order to be able to properly evaluate the general quality of the finished work and to be able to furnish a report as to the compliance of the work with the specifications.

Visual inspection shall be made by the Soils Engineer or a competent inspector acting on their behalf at the following times:

(a) After any part of the existing ground has been finally stripped and prepared and before the placing of any fill on that ground.

(b) Before and after any drain has been installed and at appropriate times as the drain is covered by fill.

(c) At such other times as the Soils Engineer considers necessary to be able to assess the general standard of earthworks and to reasonably satisfy himself/herself that:

- Fill is not placed over soft or organic material
- All areas of existing ground showing seepage or potential seepage have relief drains provided
- Compaction operations are systematic, the water content of fill material is suitable and the degree of compaction is consistently satisfactory
- Unsuitable materials as defined by the Engineer are not being used as fill.

During the construction of earth fills the following quantitative control tests shall be made on fill material:

(a) Tests to determine whether the water content is at optimum

(b) In situ density tests to determine whether the degree of compaction is up to the specified minimum

(c) Where appropriate tests to determine the maximum dry density for the soil tested in each in situ field density test

(d) Such other tests as may be specified by the Soils Engineer for control testing of fills or particular soil types, providing that the soil property tested shall be related to in situ density or water content of the fill by a laboratory investigation. Such tests to include shear strength tests, cone penetrometer tests and Proctor needle tests.

Once the filling work is progressing as a steady operation with uniform compaction methods and provided that -

(a) Adequate compaction effort is being maintained

(b) Adequate visual inspection is being maintained

(c) The specification requirements are being met,

then the minimum frequency of control testing shall generally be one in situ density test (or equivalent) for each 2,000 m³ or 1.0m lift of fill. Testing shall be more frequent than specified above, under any of the following circumstances:

- During the first 4000 m³ of filling carried out on the project.
- On the final layer of not less than 1.0 m depth.
- When soil type or conditions are variable.
- When the Soils Engineer or his inspector is in any doubt about the adequacy of construction methods or soil properties.
- When a decision to reject work based on the judgment of the Soils Engineer or his inspector is disputed.
- When relatively small quantities of fill are concentrated in localised areas or placed discontinuously over a long period of time.

The locations of tests shall be decided by the Soils Engineer or his inspector, who shall select them so as to test the material that is likely to have had the least compaction. In addition, a proportion of tests shall be taken at random locations to check the average standard being obtained.

All field and laboratory test data shall be recorded in a systematic manner that will allow the results to be identified and allow the calculations to be checked at a later date, if necessary. All control test results shall have recorded the time, date, location and elevation. Where work is rejected on the basis of either test results or visual appraisal, the Soils Engineer shall record the extent of the rejected work and the type of remedial work. This information shall be furnished in his report on completion of construction.

2.7 FINAL DOCUMENTATION

2.7.1 As-Built Drawings

On completion of the earthworks an As-Built plan conforming to the requirements of this code (appendix E) of practice shall be prepared. The As-Builts shall include a site plan showing the borelog and test positions and a plan showing the extent of all certified and uncertified fills, the location of any building restriction lines, an extent of the cut and fill contour plan at 1m intervals and the position of all sub-soil drains or other constructed features underground.

2.7.2 Soils Engineer's Report

On completion of construction the Soils Engineer shall furnish for the Engineer two copies of a report together with a statement of professional opinion in the form prescribed in NZS 4431, describing the extent of the inspection and the results of testing together with a statement of professional opinion as to the compliance of the filled ground for specified types of building construction and where applicable, the suitability of original ground for specified types of building construction and that it complies with the relevant rules in the District Plan of the Council and other requirements as may be stipulated in the Resource Consent.

A suitable format for the statement of opinion is included as Appendix A.

2.7.3 Asset Data Standard Specification

A technical specification for the supply of GIS data in electronic format is provided in Appendix E of this code. This data shall be provided at the same time as the As-built drawings, Road Asset Data forms and the Soils Engineer's Report.

PART 3: ROADS

3.1 SCOPE

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

3.2 GENERAL

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

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

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

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

3.2.1 The Road Pattern and Hierarchy

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

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

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

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

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

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

3.2.2 Parking

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

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

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

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

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

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

3.2.3 Carriageway, Road and Formation Widths

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

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

TABLE 3.1: MINIMUM ROAD PROFILE

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

Footnotes:

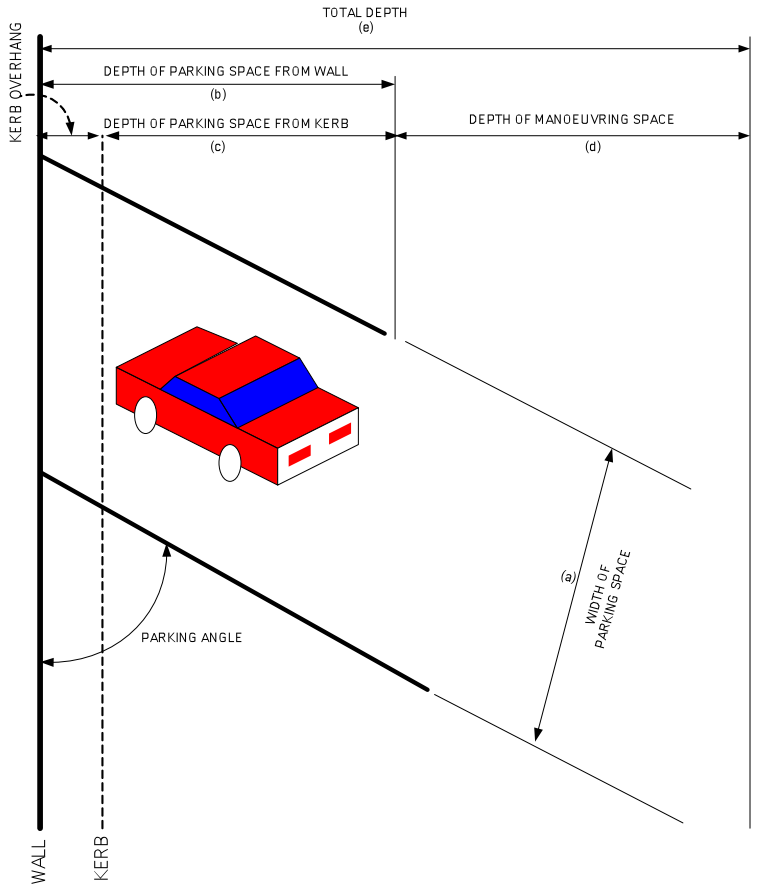
(1) Indicative traffic volumes includes all potential future traffic generated from the catchment accessed by the road (assessed at 10 v.p.d./dwelling unit).
(2) Where cycle use can be anticipated, an uninterrupted cycle path of 1.5 m in width is required along the kerb (to be delineated by a 150 mm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

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

TABLE 3.2: PARKING SPACE DIMENSIONS

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

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



3.2.4 Carriageway Geometrics

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

3.2.5 Pedestrian and Bicycle Traffic

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

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

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

3.2.6 Road Lighting

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

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

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

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

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

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

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

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

TABLE 3.3: SUGGESTED CATEGORIES AND SPACINGS

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

3.2.7 Drainage

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

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

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

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

3.2.8 Landscaping

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

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

3.2.9 Standards and Guidelines

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

3.2.10 Bylaws

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

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

3.3 ENGINEERING DESIGN

3.3.1 Road Geometry

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

3.3.2 Longitudinal Gradients

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

3.3.3 Vertical Curves

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

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

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

TABLE 3.4: SAFE STOPPING SIGHT DISTANCE

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

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

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

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

3.3.4 Horizontal Curves

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

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

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

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

3.3.5 Superelevation and Crossfall

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

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

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

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

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

Sealed pavement	3%
Unsealed pavement	6%

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

3.3.6 Carriageway Crossfall

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

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

3.3.7 Intersection Design

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

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

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

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

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

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

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

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

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

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

TABLE 3.5: MINIMUM DESIGN CRITERIA FOR ROUNDABOUTS

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

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

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

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

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

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

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

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

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

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

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

3.3.8 Cul-de-Sac Heads

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

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

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

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

3.3.9 Crossfall on Grass Berms

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

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

3.3.10 Road Pavement

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

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

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

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

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

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

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

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

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

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

Aggregate requirements are presented in Table 3.6.

TABLE 3.6: PAVEMENT AGGREGATE REQUIREMENTS

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

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

SUMMARY SCHEDULE OF AGGREGATE MATERIAL PROPERTIES

TABLE 3.7: AGGREGATE STRENGTH & QUALITY

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

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

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

TABLE 3.9: AGGREGATE GRADING SHAPE CONTROL

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

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

Limerock shall not be accepted as GAP 65 aggregate.

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

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

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

Use of Woodhill Sand

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

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

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

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

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

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

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

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

TABLE 3.10: MAXIMUM BENKELMAN BEAM CHART

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.3.11 Traffic Services

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

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

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

3.3.12 Bridging

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

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

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

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

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

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

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

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

3.3.13 Subgrade Drainage

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

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

3.3.14 Kerbing and Channelling

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

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

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

3.3.15 Catchpits

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

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

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

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

(d) A double catchpit shall be provided:

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

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

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

3.3.16 Dished Channels

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

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

3.3.17 Footpaths/Accessways

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

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

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

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

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

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

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

3.3.18 Crossings

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

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

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

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

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

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

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

3.3.19 Berms

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

PART 4: STORMWATER

4.1 GENERAL POLICY

4.1.1 Overview of Drainage Infrastructure Services in Papakura

The urban area of the Papakura District is serviced by a public stormwater system which contributes greatly to the health and safety of our community, and well-being of our much valued terrestrial and coastal environments.

The public stormwater network is operated and maintained by the Council. The network includes approximately 194km of pipe, 32km of open channels, 448 inlet/outlet structures and 3,202 manholes as at year 2005. There are also stormwater treatment ponds and other devices at various part of the District.

4.1.2 Stormwater Management Objectives

The objectives of stormwater management in Papakura District Council are:

1. To provide an adequate stormwater drainage system including the primary drainage system and the secondary overland flowpaths system to minimise flooding of properties and public roads and frequent drainage nuisances to general public.
2. To protect the stream bank and properties from excessive erosion which could cause instability to land.
3. To maintain and improve the water quality in the fresh and marine water receiving environment. To continually improve the amenity value and habitat in the stream and associated riparian reserve.

The above objectives can be achieved through:

1. Undertaking catchment management study in an integrated systematic approach to assess the effects of future developments in the catchment area and identity a range of remedial options.
2. Incorporating low-impact development measures in new development if practicable.
3. Protection of the stream riparian margin and minimise infilling of 1% AEP flood plain.
4. Implementing remedial works to augment the capacity of the stormwater drainage system by removing bottlenecks.

4.1.3 Stormwater Catchments and Catchment Management Plans and Comprehensive Discharge Permits

All new stormwater assets are to comply with relevant integrated discharge consents and integrated catchment management plans.

There are a total of five integrated stormwater management areas in the district. A map of all catchment boundaries is included as Standard Drawing SW2. Table 4.1 shows a list of Catchment Management Plans currently held at Council. Catchment Management Plans may be viewed by arrangement with the Stormwater Asset Manager.

Table 4.1 List of Stormwater Catchment and CMPs

ICMP Area	ICMP Study Area	Stormwater Catchment	CMPs	NDC Consent/Expiry	Comments
Papakura Stream	Papakura Stream	Alfriston	Papakura Stream Flood Management Study and Plan (ARC, TP29A, 1993)		Rural catchment with potential development beyond year 2050
		Alfriston East			
		Porchester			
	Takanini North	Takanini North	Takanini North Catchment Management Plan (Consented, 2004)	Permit No. 24814 Expiry: 31/Dec/2022	
	Ardmore	Ardmore			Airport has its own discharge consent. The remaining catchment is rural and will stay rural for the foreseeable future.
Pahurehure Inlet	Pahurehure Inlet North	Conifer Grove			Misc discharge consent obtained by various developers. However, most have not been transferred to PDC.
		Longford Park			
		Takanini South	Takanini South Catchment Management Plan	Permit No. 24670 Expiry:31/Dec/2022	
		Youngs			
	Central Papakura	Old Wairoa Road	Old Wairoa Road Catchment Management Plan	Permit No. 27850 Expiry: 31/Dec/2038	
		Elliot			NDC Applied in 2001
		Prince Edward			
		Pahurehure			
	Hingaia North	Hingaia North	Hingaia Stage 1 Catchment Management Plan	Permit No. 27850 Expiry: 31/Dec/2036	
Slippery Creek		Croskery Road Drain	Slippery Creek Catchment Management Plan	Permit No. 928081 Expiry: 31/Dec/2028	
		Bellfield			NDC applied in 2001 (also named Opaheke)
		Slippery Creek			

ICMP Area	ICMP Study Area	Stormwater Catchment	CMPs	NDC Consent/Expiry	Comments
		Rural			
Drury Creek		Hingaia South			
		Hingaia Stream			
		Drury Triangle			NDC application at ARC
		Ngakoroa Stream			Rural Catchment. Upstream catchment in Franklin
		Oira Stream			
		Jesmond			
		Drury Town			NDC applied in 2001
Upper Taitaia		Upper Taitaia			Rural Catchment

4.1.4 Health and Safety Requirements for Working on Public Stormwater Assets

Public stormwater infrastructure can be a hazardous working environment, thus access to public stormwater infrastructure is restricted to protect the health and safety of the workers and general public.

No person may access public stormwater pipes, manholes, chambers and drains without an approved planned work permit obtained from the Stormwater Asset Manager at Papakura District Council.

Any persons or parties granted access to work on public stormwater infrastructure must have a current and specific health and safety management plan in terms of the Health and Safety in Employment Act 1992 (and amendments).

The Health and Safety Plan shall deal with the identified hazards, including the following:

- Hazardous fume and gases accumulated in pipes and manholes.
- Confined space.
- Flash flooding in stormwater system.
- Drowning in water body, including ponds, wetlands and open drains.

4.1.5 Building Over or In Close Proximity of Public Drains

Building over or in close proximity of public stormwater infrastructure is discouraged and the last option, which may be discretionally granted by Council depending on the circumstance. Every endeavour shall be made by the developer and its engineer to avoid this as building over can greatly limit the future maintenance access and renewal options of critical asset. Detailed specific building design is required. An engineering report investigating all available options will be required to accompany any application.

If any proposed development is within 20m of Watercare Services' pipelines, then written approval from Watercare Services Limited will be required.

Building over private drain serving the property it runs through or adjacent properties, is generally not permitted. The option of realigning the private drain outside the proposed building platform is preferred. Modification to the easement and consent from the affected owners will be required.

4.1.6 Modifications to Existing Public Asset (diversion, realignment, relay and decommissioning of public assets)

Modifications to existing public asset shall generally be avoided in any development. Depending on the circumstance, Council Development Engineer may discretionally approve diversion, realignment and decommission of existing public assets.

Any modifications to the public system shall not compromise the level of service of the existing public system in terms of hydraulic capacity, self cleansing velocity and its potential in serving future probable development in the catchment areas.
An engineering report investigating all the options available and hydraulic calculation from a qualified engineer will be required to accompany any development proposal lodged at Council.

An application for any modification to existing public asset shall be submitted to Council for approval.

4.1.7 Extension of Public Drains

Council, at its discretion, may extend or add new infrastructure to the existing public system to improve or enhance the performance of the existing public system.

4.2 STORMWATER DRAINAGE

4.2.1 Definition of Public Stormwater Drain

The definition of what a Public Stormwater System is and when it is not available is as follows:

1. All public stormwater drains are shown on the Papakura District Public Stormwater Drainage Maps (available via the PDC GIS system).

2. The Public Stormwater System in the Urban Zone does not include :
   roadside kerb
   catch-pit in the road reserve
   common private drains

3. The public stormwater system in the Rural Residential Zone is identical to that of the Urban Zone but does not include the following:
   Open drains in the road reserve
   All natural watercourses.

4.3 FLOOD HAZARD AREAS

Council maintains flood hazards maps for the district. The maps are generally based on historic catchment studies and reported flooding problems in the district.

For any new development or alterations to existing development within the proximity of flood hazards area, advice should be sought from a chartered professional engineer experienced in catchment hydrology on the general layout of the development in the flood plain or safe building floor levels.

The Papakura District Plan restricts development in the 1% AEP flood plain especially for those involving filling in the flood plain.

4.3.1 Minimum Floor Levels and Freeboards

The habitable and non-habitable floor levels of buildings shall be determined based on SW24, catchment management plan and other specific studies related with the development site.

In general, the habitable floor levels shall be above the analysed 1% AEP flood level at the upstream side of the building with a minimum freeboard of 300mm. The non-habitable floor levels shall be above the analysed 10% AEP flood level at the upstream side of the building with a minimum freeboard of 200mm. The freeboards may be increased where the stream channel is narrowly confined with potentially significant variations in peak flood levels, or greater uncertainties are associated with the prediction of the peak flood levels.

Residential and commercial building floors to be constructed in area subject to wide spread surface flooding problems shall have a minimum freeboard of 300mm above the maximum depth of surface flood in a 1% AEP extreme storm event.

4.3.2 Encroachment of Flood Plains

In general, no building or infilling earthworks are permitted in the identified 1% AEP flood plain. Dispensation may be granted to minor encroachment into this 1% AEP flood plain where the minor loss of the storage volume in the flood plain due to infilling has less than minor effects in maintaining the delicate hydrologic balance in the overall catchment.

Any proposed work in the flood plain will require a resource consent, application for which must include a report by a suitably qualified engineer.

4.3.3 Tidal Inundation Zone

Development in the low lying coastal area may be subject to tidal inundation. Extreme tide level can combine with other factors such as storm surge, wave run-up, and future sea level rises, may pose a significant hazard to low lying coastal properties, if the building floors have not been elevated adequately.

Typical and extreme sea levels at Onehunga, Manukau Harbour are shown on SW7. For any new buildings in the coastal area fronting Manukau Harbour:

- The minimum habitable building floor levels shall be no less than 4.6m above the Auckland Vertical Datum 1946.
- The minimum non-habitable building floor levels shall be no less than 4.2m above the Auckland Vertical Datum 1946.

Variation to this level may be considered if a specific site assessment by a suitably qualified engineer experienced in coastal engineering has been carried out. Minor alterations to existing buildings which match existing floor levels may be permitted subject to assessment of the risks.

4.4 STREAM MANAGEMENT

4.4.1 Piping of Watercourse

Piping of a permanent stream/ river on residential lot other than for roading access is generally discouraged in the District. Piping of any permanent stream or river will require a resource consent obtained from the Auckland Regional Council and Papakura District Council.

Intermittent streams in the District play critical roles in the surface water drainage system. Works, infilling, piping and any other modifications to the stream channel will potentially modify the natural drainage pattern of land, cause flooding to upstream and downstream properties if they have not been properly managed. These activities will only be approved by the Council under special circumstances when the applicant has produced sufficient evidence to prove that any adverse effects from the activity can be mitigated by the proposal.

4.4.2 Stream Crossings (Culverts and Bridges)

Stream crossings, such as culverts and bridges on any permanent stream should be avoided as far as possible and will require resource consent from the Auckland Regional Council and Papakura District Council.

The Development Engineer will also assess the engineering details of the proposal based on the following criteria:

1. The proposed stream crossing generally complies with the relevant catchment management plan.
2. The proposed stream crossing will not significantly raise the water surface profiles beyond the upstream boundary of the road reserve or the property. Any rise of water surface profiles under extreme rainfall events, if not avoidable:

   shall not endanger the habitable and non habitable floor levels of any existing buildings,
   shall not affect the further development potential of any land upstream,
   the increased flood plain extent shall not extend beyond the riparian margin.
3. The proposed stream crossing will not cause erosion at the inlet and outlet.
4. The exiting flow direction is in line with the original flow direction in the stream.
5. The maximum velocity in the conduit will not exceed 8m/s for RC pipes.
6. Fish passage can be maintained at pre-construction levels.

4.4.3 Stream Riparian Margins

The following riparian margins shall be generally provided in lack of specific requirements from relevant Catchment Management Plans, unless otherwise approved by the Stormwater Asset Manager.

Table 4.2 Minimum Riparian Margins

Natural Stream Management Areas	40m on either side
Permanent Streams in Rural Area	20m on either side
Permanent Streams in Urban or Future Urban Area	20m on either side
Intermittent Streams in Urban or Future Urban Area	5m on either side

Note:

1. The required riparian margin is to be measured from the edge of the extent of mean annual flood at the specific section of the stream.

2. The natural Stream Management Areas are shown on the Auckland Regional Plan Air Land & Water.

3. The widths of riparian margins specified in the relevant ICMP's or CMP's shall take precedence over those in the above table.

The riparian margin shall be kept clear of development. Indigenous planting in the riparian margin shall be protected and possibly enhanced during development.

The riparian margin acts as an aquatic buffer - a natural boundary between local waterways and existing development and helps protect resources by filtering pollutants providing flood control, alleviating stream-bank erosion, mitigating stream warming, and providing room for lateral movement of the stream channel.

Unsuitable plants and weeds shall be cleared from the stream channel and riparian margins, and replanted with suitable species as per the landscape design during the development. Habitat for native fish and birds shall be provided. Works shall also include the protection of the low flow channel against scour and erosion of the streambed where necessary.

4.4.4 Stream Hydraulics

The flow characteristics of all open drains, particularly natural open stream systems, shall be based on the likely long term stream condition in terms of density of vegetation and take due account of potential blockage under peak flood conditions.

4.4.5 Stream Bank Erosion Protection

It is the responsibility of individual owners to maintain the stream channel which runs through their properties. The individual owners shall ensure adequate measures have been put in place to protect the stream bank from erosion, undercutting, slippage and other instability which could undermine the safety on their/ others properties. Excessive sediment generated from stream bank erosion can also be harmful to aquatic health by smothering benthic organisms, reducing light penetration, and losing habitat in stream flows.

4.5 OVERLAND FLOW PATH MANAGEMENT

Overland flow paths form an important part of the urban surface water drainage system. Provisions and protections of overland flow paths in urban development are critical in protecting properties from flooding.

4.5.1 Definition of Significant Overland Flow Paths

A significant overland flow path is defined as:

- An overland flow path which forms the primary drainage system (no stormwater drainage pipes exist in the areas) where the 10% AEP peak discharge exceeds 50 l/s.

- An overland flow path which forms the secondary drainage system (supplementary to the primary stormwater drainage system) where the 10% AEP peak discharge in the primary system exceeds 200 l/s or the 1%AEP peak discharge exceeds 1.0 m^3/s.

4.5.2 Provision and Protection of Overland Flow Paths on Development Sites

For any proposed new development, the applicants and their agents shall identify all significant overland flow paths through the development site and on downstream properties. Significant overland flow paths on downstream properties if they have not been protected, shall be formalized as a part of the proposed development by removing obstructions and even notified on titles as covenants.

In general, overland flow paths conveying a design flow of 1.0 m^3/s or greater shall be located within Council owned land such as roads, pedestrian access ways, dedicated drainage reserves etc.

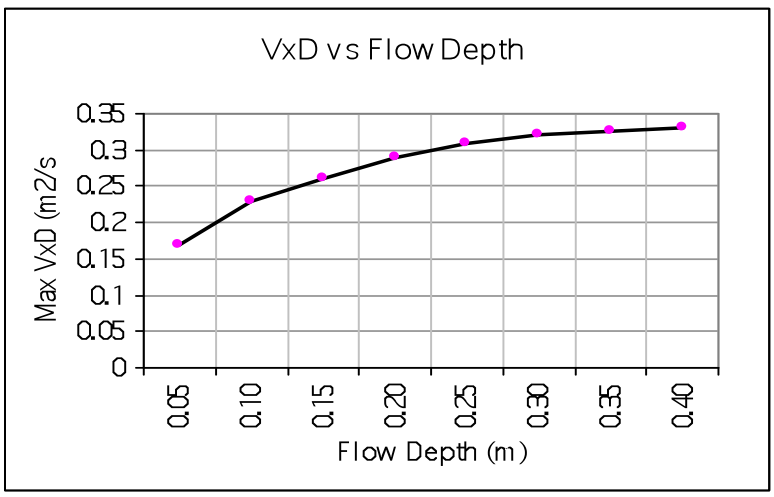
Where significant overland flow paths conveying design flow of less than 1.0 m^3/s and cannot be reasonably located in Council owned land, they may pass through the new lots. In such cases an appropriate easement in gross in favour of the Council shall be provided.

The terms of any such easements shall be worded to prevent the erection of buildings, structures or other obstructions which may impede the flow in the overland flow paths, shall require appropriate maintenance by the landowner(s).

Insignificant overland flow paths passing through new lots will not require an easement. However, a notice will be placed on the property file and Council's GIS system, and any proposed development of the property shall make provision for the safe passage of overland flow through the site.

4.5.3 Design of Overland Flow Paths

Overland flow paths shall be designed in a manner that ensures that the combination of flow velocity and depth do not create a hazard. Generally, the product of the velocity (V) times flow depth (D) under the 1% AEP storm event shall not exceed the values given in the following graph.



The maximum depth of flow in an overland flow path under a 1% AEP extreme storm event shall be less than 0.5m

4.5.4 Maintenance of Overland Flow Paths

All newly identified significant overland flow paths shall be registered on the titles of affected lands with a memorandum listing out the owner/s responsibility.

The overland flow paths shall be made clear of obstructions at all times. No building or other permanent or temporary structures, which could potentially block the overland flow, shall be placed across the overland flow paths.

Any fence lines across the overland flow paths shall be made with pool fence, or alternatively, the lower rail shall be made at least 400mm above the ground surface beneath the fence, and clear openings beneath it be maintained between the posts.

4.6 STORMWATER RECHARGE IN PEAT AREA

4.6.1 General Policy on Stormwater Recharge

There is a significant area of peat and soils with high organic content in the Papakura District, as shown in SW3. The majority of this area is planned for either future urban development, or infill subdivisions. This reduction in pervious area will in turn reduce the amount of rainwater that infiltrate into the soil and recharge the groundwater, which may result in gradual lowering of the groundwater levels. This is a serious issue in peat soil areas because dewatering the peat soils may result in consolidation, which can cause significant damage to roads, building foundations, and underground services.

In order to maintain the groundwater levels as close to their current state as possible, a recharge pit will be required on every new development or subdivision within the peat areas. Site specific investigations should be carried out to check for the presence of peat to determine the need for a recharge pit. This recharge pit will collect a proportion of the stormwater runoff from the roofs of the new development. This water will be left to infiltrate into the soil, and recharge the localised groundwater table.

The recharge pits have been designed to retain the stormwater runoff from all impervious areas from the first 15mm of any rainfall event. However, to prevent sediments from clogging the pit, only water from the roofs of new developments will be diverted to the recharge pit. Runoff from other impervious areas will require treatment to remove coarse sediment and other gross pollutants prior to discharge to the recharge pit.

4.6.2 Engineering Design of Recharge Pit

Specific engineering design is required for stormwater re-charge in peat areas. As a minimum:

1. The recharge pits are required for all new developments with over $50m^2$ impervious area. This includes additions to existing structures, residential infill subdivisions, and large scale Greenfield residential or commercial developments.
2. The total site impervious area threshold for requiring a recharge device is $50m^2$, however all developments between $50m^2$ and $100m^2$ require a device sized for

100m^2. Any development on a site that increases the impervious area by 20m^2 or more will require a recharge pit sized for and connected to the entire impervious area of the site.

3. The largest contributing catchment for one recharge pit is 1000m^2 new impervious area. For developments with over 1000m^2 new impervious area, a number of recharge pits will be required. These shall be spaced equidistantly around the site where possible, with the locations to be confirmed with PDC.
4. For residential infill subdivisions in existing developed areas, only the new development will require a recharge pit.
5. Recharge pits must not be located within three metres of buildings or site boundaries. Where this is not practical, a site geotechnical investigation report, and possibly an alternative recharge pit design, must be undertaken to take into account the effect of the device on building foundations.
6. Runoff from ground level impermeable areas, such as driveways and patios, should be treated prior to entry into the recharge device. The pre-treatment options shall be in accordance with ARC TP10, which details devices such as swales, filter strips and coarse sediment traps. These pre-treatment devices shall be sized for 10% of the Water Quality Volume in accordance with ARC TP10.
7. A minor geotechnical investigation is required to confirm that the soil conditions in the proposed location of the recharge pit are similar to the generic conditions described above and that the recharge pit will connect to the peat layer. The required results from this investigation are as follows:
   - Depth to top of peat layer
   - Depth to groundwater level
8. If the depth to the peat layer or the groundwater level is less than 1m or greater than 2.5m, consultation with the Development Engineer will be required to determine whether an amended version of the standard design or a different site specific groundwater recharge device is required.
9. For large ground level impermeable areas such as carparks, the recharge pits should again be located at the end of a treatment train. Devices such as swales, rain gardens or sand filters are possible, however special care must be taken in the design of the entire treatment train to ensure that the recharge pit can be located at the appropriate depth below ground level.
10. These devices may not be suitable for new roads where there is limited space available in the road reserve. In general, devices such as rain gardens, swales and filter strips should be used where recharge devices are infeasible in order to maintain some form of ground recharge.
11. It is at Papakura District Council's discretion as to whether new roads in these areas will require these recharge devices.

4.7 STORMWATER SOAKAGE

Ground soakage systems may be used as primary or secondary means of stormwater disposal associated with new or existing developments if the general geological condition permits.

1. When the soakage system is used as the primary stormwater disposal system, the soakage system shall be designed with adequate soakage surface areas and live storage volume to cope with run-off from a range of 10% AEP storm events with durations varying from 10 minutes up to 72 hours.
2. When the soakage system is used as the secondary stormwater disposal system supplementary to the primary piped reticulation system, the system may be designed with a capacity to cope with run-off from events less than 10% AEP, and an overflow system should be provided to connect to the primary piped stormwater reticulation system.
3. The recovery periods for all soakage systems shall be no more than 24 hours from the end of the storm event. The recovery period refers to the time taken to drain the maximum live storage until it is empty via ground soakage.

Soakage devices shall be positioned on site where:

4. Adequate access for maintenance can be maintained on a long term basis.
5. It is no closer than 3.0m from the closest point on the outline of a building and no closer than 1.5m from a boundary with another property, unless specific geotechnical advice has been given and the affected parties have given written consents.
6. It is not less than a horizontal distance equal to the height of a retaining wall plus 1.50m from a retaining wall.
7. It is not less than 2.0m from a public drainage system.
8. The failure of the soakage system will not result in flooding of any buildings, or cause instability to this or any adjacent lands.
9. It is not shared between private properties.

The chosen runoff coefficient shall be based on the conditions likely to exist after the full development of the catchment area.

The rainfall intensities shall be based on the Council's Design Storms and relevant Depth-Duration-Frequency chart.

Refer Soakage Pit Design example methodology in Appendix C.

4.7.1 Percolation Test

1. A percolation test is to be carried out on site to assess the rate at which the stormwater will soak into the ground. A minimum one test bore hole shall be drilled at the location of each proposed soakage system.
2. Boreholes shall be a minimum of 100mm diameter and should be bored to at least 1.5m below the topsoil layer or reaching a depth of unable to penetrate. Boreholes are to be geologically logged in terms of the soil layers and types.
3. Prior to commencing the percolation testing the boreholes must be thoroughly pre-soaked to simulate winter conditions during Spring, Summer and Autumn seasons. In September – May holes must be kept full for a minimum of 17 hours prior to testing.

During winter months (June, July and August), holes must be kept full for a minimum of 4 hours. This will normally provide adequate time for the soils surrounding the hole to become saturated, and for any clay soils to swell.

4. Percolation testing can be carried out as a Falling Head or Constant Head test. A falling head test consists of determining the percolation rate of an area by filling the boreholes with water and recording the rate at which it drains away. Constant head test determines the percolation rate of an area by maintaining a constant head of water in the boreholes. Water that drains away is replenished at the same rate and the rate recorded.
5. Percolation tests shall be carried out in soils below the topsoil layer, and not less than 200mm below the existing ground level.

4.7.2 Minimum Percolation Rate

The guideline for the minimum percolation rate is 0.25 litres/m^2/min. Percolation test rates less than 0.25 litres/m^2/min are to be retested by an IANZ (International Accreditation New Zealand) Laboratory qualified to do percolation tests, and the applicant shall demonstrate adequate site area will be available to accommodate a soakage system relying on very low percolation rates.

4.7.3 Approved Soakage Devices

There are six main types of soakage devises that are approved by Council. These being Onehunga soakholes, Filter-strip soakholes, Rain-gardens, Rock-bore soakholes, Porous paving, and Nominal soakholes for catchment areas less than 20.0m^2. Nominal soakholes are typically scoria filled pits.

A coarse sediment trap such as a catch basin in the access chamber shall be used to minimise the cleaning frequency of the soakage system.

The engineer shall recommend an operation and maintenance schedule and inform the future owners their responsibilities in maintaining the proper function of the soakage system.

4.7.4 Falling Head Percolation Test

Falling head percolation tests determine the percolation rate of an area by filling a borehold with water and recording the rate at which it drains away. This test method is most suitable for use in soils with a medium to low permeability.

To carry our a falling head percolation test on a borehole;

1. Note percolation rates are likely to be below 1.0 litres/sqm/min
2. Thoroughly pre-soak the borehole according to the instructions in Section 4.7.1 part 3
3. Fill the hole with water to a level between 200mm and 350mm below the ground level or to a level below the topsoil layer, whichever is the deeper. Record the depth/level of the water and record the drop in water level against time at evenly spaced intervals of no greater than 20 minutes, until the water level is around 0.20m from the base of the hole or 4 hours has passed.

Where the hole drains quickly, the test should be repeated several times (would expect a minimum of four times or repeat tests to the lapse of the 4 hour period).

4. Graph the results and derive the percolation rate in litres / m^2 / minute from the average slope of the curve at the middle to low section (ignore the initial fast draining period).

4.7.5 Constant Head Percolation Test

Constant head percolation tests determine the percolation rate of an area by maintaining a constant head of water in a borehole. The water that drains out of the borehole is replenished with water at the same rate from a water source such as a fire hydrant. The stabilised flow rate of water entering the borehole is measured over time to determine the permeability of the soil.

To carry out a falling head percolation test on a borehole;

1. Fill the borehole using a pipe connection to a flow meter. Observe the water level and adjust the hydrant valve until the bore is maintained close to full. This step must be continued for at least 10 minutes to ensure that the hole is adequately pre-soaked

2. Borehole positioned within 10.0m of each other must be tested simultaneously

3. Continue the test for a further 10 -15 minutes, and ensure a constant water flow rate is achieved

4. Apply a factor of safety of 1.4 to account for the likely reduction in future soakage rate due to clogging

5. Convert the flow rate into a litres/m^2/minute percolation rate.

4.8 STORMWATER QUALITY AND QUANTITY MANAGEMENT DEVICES

4.8.1 Stormwater Quantity Management

Stormwater quantity management measures may be required for a new development by Council under the following circumstances:

1. Where a catchment management plan has identified such a requirement.
2. Where downstream flooding problems have been identified and the most practicable solution is to incorporate stormwater quantity control in the upstream catchment.
3. Where downstream channel erosion has been identified.
4. Where a resource consent condition requires stormwater quantity management.

On many occasions, stormwater quantity management measures can be incorporated into stormwater quality treatment devices.

Approved stormwater quantity management measures include:

- Extended detention
- Low impact design techniques
- The stormwater detention tanks

4.8.2 Stormwater Quality Management

Stormwater treatment will generally be required for discharge from an impervious catchment area of more than 1000m² or from a high environmental risk activity site (as per The Auckland Regional Plan: Air, Land and Water).

All stormwater quality and quantity management devices shall be designed in accordance with ARC TP10 Design Guideline Manual: Stormwater Treatment Devices 2003 and PDC Stormwater Ponds/Wetland Design Guidelines (June 2005).

For all proposed stormwater quality and quantity management devices for vesting to Council as public assets, the applicant shall consult and obtain prior approval of the Development Engineer.

4.8.3 Low Impact Urban Design (LID)

Low impact urban design is a design approach that incorporates engineering features that minimise stormwater runoff and sediments and other contaminants in the stormwater runoff, thus reducing the impact of urban development on the downstream receiving waterways.

Council encourages developments to incorporate LID features in the District.

Typical LID features include:

- Use of low environmental risk roof materials
- Use of permeable pavement systems
- Rain tanks for water re-use
- Rain gardens
- Swales.

The ARC TP124 "Low Impact Design Manual" provides guidance on low impact urban design in the Auckland Region. Well designed LID features may provide an economic alternative to traditional stormwater management measures.

For all LID features, the applicant shall consult the Development Engineer to ensure their compliance with the ICMPs and Asset Management Plan.

4.8.4 Operation and Maintenance Requirements

An operation and maintenance manual including procedures, initial settings and other specific requirements for operation, and a maintenance schedule detailing the tasks and occurrence frequency, shall be prepared for the stormwater quantity and quality management devices.

The operation and maintenance manual shall generally be required for new assets such as stormwater management devices including constructed wetland, pond, sand

filter, rain garden, or detention pond, etc. Council may require an Operation and Maintenance Manual to be prepared for any other unusual and new asset items proposed for a new development, as a condition of the engineering plan approval.

4.9 STORMWATER DISCHARGE

Where stormwater is discharged into existing streams, rivers, ephemeral streams, significant overland flowpaths or the sea, the following conditions shall apply:

- A suitable outfall and energy dissipation structure shall be constructed at the outlet to ensure no erosion occurs. This structure shall be specifically designed in such a way as to blend in with the immediate natural surroundings.
- The direction of the discharging pipeline shall be aligned with the flow direction in the stream or other receiving water to reduce erosion from localized turbulence.
- A resource consent, if required from the Auckland Regional Council, shall be obtained.

4.10 RESOURCE CONSENT FROM REGIONAL COUNCIL

Any resource consent from the Regional Council in respect of the permanent diversion of natural water will be exercised in the name of the District Council once the development has been accepted as complete by the District Council. The developer shall make the initial application in the name of the developer.

Any resource consent covering the discharge of stormwater will be exercised in the name of the Council, when the system has been accepted as completed by Council. The developer shall make the initial application in the name of the developer.

The Council should also be consulted as it may hold a Comprehensive Water Permit for the whole catchment, in which case a separate permit will not be required from the Regional Council.

All elements of new stormwater assets within a development are to be approved by the Council. Obtaining consents from the Regional Council in no way negates this requirement, and application to the Regional Council for consent shall only be made after obtaining approval in principle from the Council Development Engineer.

4.11 PRIMARY DRAINAGE SYSTEM

4.11.1 Catchment and Land Uses

The stormwater drainage system shall be capable of serving the entire contributing catchment upstream of the development, under the maximum probable development scenario likely to prevail during the useful life duration of the system. The design life shall not be less than 80 years, for the main components such as manhole structures and pipelines.

4.11.2 Design Storms

The primary reticulation system shall be designed to have adequate hydraulic capacity to pass the peak flows from the following minimum storm events without surcharges in manholes:

- Residential Areas 10% AEP
- Commercial and Industrial Areas 10% AEP

The reticulation system in commercial and industrial areas where 100% site coverage is permitted by the District Plan, and no overland flow path can be provided, shall be designed for 1% AEP storm events together with engineering measures to prevent blockage of the pipe system and inlets.

4.11.3 Hydrological Analysis

The peak flows and total runoff volumes for the design storms shall be analysed using the methodology in ARC TP108 "Guidelines for Stormwater Runoff Modelling in The Auckland Region" (April 1999), or the Rational Method as described in New Zealand Institution of Engineers Auckland Branch "A Guideline and Procedure for Hydrological Design of Urban Stormwater Systems (Dec 1980)". Any other hydrological analysis method shall only be used with specific approval from the Development Engineer. Council's rainfall Depth-Duration-Frequency data can be used with the Rational Method.

4.11.4 Time of Concentration

Initial time of entry (te) shall be 8 min 30 sec. Network flow time (tf) shall be time of flow in pipes or channel to design point. The Time of Concentration shall be the sum of te and tf. The minimum initial time of concentration for design purposes shall be 10 minutes.

4.11.5 Runoff Coefficient

The following composite runoff coefficient can be used with the Rational Method:

Table 4.3: Runoff Coefficient

Road Reserves	0.85
R.O.W/Access Lots	0.95
Residential Lots	0.75
Industrial/ Commercial Lots	0.95
Pervious Areas	Refer to "Guidelines and Procedure for Hydrological Design" Section 4.3

4.11.6 Hydraulic Design of Pipelines

The hydraulic design of stormwater pipelines shall be based on the Colebrook-White formula or the Manning's Equation. The Colebrook-White roughness co-efficient of Ks = 1.50mm for concrete pipes up to and including 1000mm in Diameter and Ks = 0.6mm for larger concrete pipes shall be used. For stormwater pipes of other materials, roughness factors from manufacturers' publication for aged wall surfaces with sediment debris accumulation at pipe inverts shall be used.

Hydraulic design of culverts shall be in accordance with "Hydraulic Design Manual New Zealand Edition" (Concrete Pipe Association of Australasia, Dec 1997) or alternatively in accordance with "Hydraulic Design Series Number 5 - Hydraulic Design of Highway Culverts" (US Department of Transportation - Federal Highway Administration, revised May 2005)

The design shall provide that:

(a) Road catchpit outlets shall be not less than 225 mm diameter; or exceed 40 m in length.

(b) Catchpit leads shall not be connected to more than one catchpit.

The minimum pipe gradient shall be such that a minimum velocity of 0.7 m/s under a flow equivalent to half of the 50% AEP peak discharge from the catchment shall be achieved.

Evidence of this is to be provided for any pipe designed with a gradient of less than 1% (1 in 100).

4.11.7 Outfall Water Levels

The water level at the stormwater outfalls is critical in determining the water surface profile through the upstream stormwater pipe network. The following general guides shall be followed when deciding the water levels at the outfalls:

1. Using computer modelling package to simulate the true water level in the receiving system.
2. If the stormwater outfall is only draining a small tributary catchment with a short time of concentration, and the receiving drain or stream drain a much larger catchment with longer time of concentration, then the true water level at the receiving drain or stream corresponding to the peak flow at the time of concentration of the small tributary catchment shall be used. A freeboard of at least 0.3m may be applicable to take into account the inaccuracies associated with the flow estimation, channel geometry and channel roughness factors.
3. If the time of concentration of the catchment for the receiving drain or stream is less than 20 minutes, then the peak flood level at the receiving system shall be used.
4. If the stormwater discharges into a tidal influenced area, the water levels shall be determined as the mean high water spring plus 0.5m to allow for storm surges and wave run-ups, etc and/or a 10% AEP extreme high tide level for half peak design flow conditions. A backflow prevention device such as a Tideflex or a flap gate may be used at the outfall to prevent seawater inundation of upstream pipes.

All stormwater systems discharging through submerged outlets must be modelled.

4.12 DESIGN OF STORMWATER DRAINAGE RETICULATION

4.12.1 Service Connections

Each proposed lot shall be served by a stormwater drainage connection located approximately 1.5 m inside the main body of the lot. Each new lot will require a separate connection.

Each stormwater connection shall be capable of serving of the whole of the building area of the lot including the driveway and other paved area on site by gravity from a ground level discharge, except where this requirement seems unreasonable and it can be shown that the proposed connection is adequate for a predetermined building location.

Unless otherwise required by the council, where a connection point is 1.5m or greater below ground level, a ramped riser shall be installed to bring the connection point to within 1.2m of ground level. Refer standard drawing SW18.
A drainage connection to any lot shall originate on a public drainage line which may lie in the immediately adjoining lot. However any such connection will be a private drain, and shall be covered by a drainage easement in favour of the lot being served, where it passes through an adjoining lot. Such private lines shall not cross more than one property boundary (this does not include the road boundary) or be longer than 50 metres.

All connection pipes shall be a minimum of 100mm diameter and shall be sealed by removable sealing caps.

Connections to pipelines shall be factory made Wye junctions. Connection to manholes shall be via drilled holes and all gaps sealed with epoxy mortar.

All connections shall be accurately indicated on As-Built plans with the distances in metres from the downstream manholes.

On developments where less that 4 additional lots are being created, each stormwater connection shall be marked by a minimum of 50mm x 50mm timber stake extending 600mm above ground level and painted blue or otherwise clearly identified as a stormwater connection indicator. This marker shall terminate a minimum of 300mm above the access cap of the service connection.

Where settlement is expected to occur, all service pipes installed within or under earthfilling shall be designed and constructed to ensure adequate capacity, strength and water-tightness to withstand the loads due to settlement and to prevent leakage into the fill.

4.12.2 Stormwater Reticulation Layout

Stormwater drainage pipelines shall generally be sited in front, side and rear yard areas of the lot well clear of future building footprint or in reserve areas. Pipelines adjacent to boundaries shall be a minimum of 1m clear of all boundary lines and at least 1m clear of the edge of foundations.
The outer edge of any manhole structures shall be at least 1m from boundary lines and edge of foundations.

For pipelines and manholes, either directly under or adjacent to, retaining walls, building foundations and any other structures, the engineer shall be convinced himself that future maintenance, repair and renewal of the pipelines and manholes will not adversely affect the overall stability of these structures.

Stormwater reticulation pipelines and manholes in road reserves are permitted provided that they don't interfere with other utility services.

The minimum vertical clearance between any two crossing pipelines shall be 300mm, measured from the outside of pipe collars. Where unavoidable, the Council Development Engineer may approve a clearance of less than 300mm subject to specific design.

A good stormwater reticulation design shall ensure:

- Uninterrupted access to all parts of the reticulation for inspection, maintenance, repair and renewal. Manhole access shall be provided to ensure access to pipelines by equipment for CCTV inspection, water jetting, root cutting and inline replacement.
- Safety of stormwater system operators.

The vertical and horizontal alignment of pipelines between two access points shall be straight. Horizontal and vertical curves within the tolerance specified by the pipe manufacturer may be approved by the Council Development Engineer under special circumstances.

Road crossings are to be at 90^{o} wherever possible.

Stormwater pipelines which collect water from public roads or serve two or more properties may at Council's discretion and on satisfactory completion be taken over by the Council as part of the public system.

Public drains will be required to terminate with a manhole and have a minimum diameter of 225 mm.

All lots in Rural Areas that do not have direct physical access to existing natural watercourses shall provide a drainage system approved by the Development Engineer.

4.12.3 Pipe Joints

Pipes of less than 1000mm in diameter shall be spigot and socket type with flexible sealed joints. Reinforced concrete pipes of 1000mm and greater may be flush jointed. Flush jointed pipes shall normally be sealed with cement mortar. Where joints are left wholly or partly unsealed for subsoil drainage or other reasons, adequate provision against entry of silt into the pipeline will be required.

4.12.4 Pipe Material

Stormwater pipelines may be constructed from the following readily available materials:

- Reinforced concrete pipes to NZS/AS4058.
- PE (Polyethylene) - to AS/NZS 4130 & 4131 - PE 80 SDR21 for thrusting installation or where a fully sealed pipe system will be required.
- PVC (Poly Vinyl Chloride) – to AS/NZS 1524 and AS/NZS 1260 for acidic groundwater or soil conditions.

The use of PE and PVC pipelines will require specific written approval from the Development Engineer.

Pipe material shall be selected based on their durability in the site groundwater and soil environment. Concrete pipes and manholes for use in peat soils shall be manufactured using sulphide resistant cement.

4.12.5 Pipeline Strength and Bedding for Reinforced Concrete Pipes

All stormwater pipelines shall be designed and constructed to withstand all likely loads to which they will be subject, both during construction and in the long term.

The pipe classes and bedding types shall be selected in accordance with NZS/AS 3725, based on the maximum depth of fill, construction load, long term traffic load and other live loads applicable. All RC pipes under public road reserve shall be a minimum of class 3 with a bedding support type of HS1. Pipe structural analysis using CPAA Pipe Class V1.3 will be acceptable.

The structural design of PVC pipes and beddings shall be in accordance with AS/NZS 2566.1:1998 Buried Flexible Pipelines Part 1: Structural Design.

Type 4 supports, as shown on DWG CM 002 NZS 4404:2004, shall be used for flexible pipes installed in open trenches.

4.12.6 Pipeline Cover

All pipelines shall be designed with adequate cover to support the likely loadings both during construction and in the long term. The following minimum cover shall be applicable:

- On private property 600mm
- Under carriageways 1200mm

Where due to topography and other limitations, the minimum cover set out above cannot be satisfied, reinforced or un-reinforced concrete protection shall be provided with specific approval obtained from the Development Engineer.

4.12.7 Anchorage for Pipes with Steep Gradient

For stormwater pipelines at gradient steeper than 10%, the bedding and surrounding shall be low grade (5 MPa) scoria concrete (mixing of 1 part cement and 4 parts scoria). For pipelines at gradients exceeding 20%, concrete anchor blocks shall be provided at every pipe joint as shown on SW20.

Specific design of bedding and anchorage will be required for pipelines with gradient exceeding 35%.

Unless required otherwise by the Engineer, where a connection is deeper than 1.2 m below ground level a ramped riser shall be constructed to bring the connection to within 1.2 m of ground level.

A typical example of a ramped riser is shown on Papakura District Council Drawing SW14.

4.12.8 Connection to Deep Lines

Where an existing or proposed stormwater pipeline is more than 5 m deep to the top of the pipe, connections shall not be made directly to it, but a new, shallower branch pipeline shall be laid from a manhole on the deep stormwater line and connections provided to the lots to be served.

4.12.9 Extended Connection

Where an extended connection is to be taken from a stormwater pipeline to the boundary of another lot a ramped riser need not be used, and the extended connection may be sloped up at a continuous gradient from the sewer, to terminate just inside the lot to be served at sufficient depth to drain the building site.

4.12.10 Pipes in Weak Ground or With High Ground Water Table (other than peat soils)

Where any pipeline is to be constructed through soft ground unsuitable for foundations, such material shall be removed and replaced with suitable fill material or such other method of construction as approved by the Water Resources Manager shall be employed to provide an adequate foundation for the pipeline. For pipelines in refuse or soils with high organic content and ground settlement is likely to occur in the future, the pipeline shall be specifically designed to allow for the adversity while ensuring proper function of the pipelines in the long term.

Where high ground water table exists, the manholes and pipeline shall be checked against floatation. A minimum factor of safety of 1.25 will be required against floatation.

Where the natural transfer of water from the trench into surrounding ground will not provide sufficient drainage, and excessive water accumulated in trench either from upstream land or leakage from the pipeline, could have adverse effects on the stability of the land or building foundations, trench drainage shall be provided to direct the water to approved outlets.

The construction of pipelines shall be carried out in accordance with the requirements of NZS 4452 and NZS 7643.

4.12.11 Pipe Construction in Peat Areas

Maintaining the current groundwater table is critical to minimize the risk of ground settlement in the Takanini Peat Areas. Piped or open drainage systems in accordance with normal engineering practice are likely to lower the groundwater table, through the following means:

1. Infiltration via faulty pipe joints,
2. Longitudinal percolation flow via porous trench fills, and
3. Reduction of flow residence time on ground surface due to effectiveness of the drainage system.

The effects of No.3 above can be mitigated by installing a proper groundwater recharge system as discussed earlier.

To counter the effects of No. 1 and 2 above, it will require specific engineering considerations when designing either an open or piped drainage system in the peat

area. The requirements on design and construction can differ greatly from those for general urban development.

It is recommended that all open and piped drains be kept as shallow as possible following the natural grade of the country. The piped drainage system shall run wherever possible above the current summer water table, i.e. generally less than 1.5m from the existing ground surface. If this is not possible then a fully sealed pipe system with water tight manholes will be preferred. Seepage barrier, such as cast in situ polyurethane collars, at regular intervals to cut off longitudinal percolation flow along the trench may also be required. The engineer shall give specific consideration to risk of floatation of manholes and pipes both during construction and after they have been installed.

4.12.12 Acceptable Standards for Defects with Concrete Pipes

All pipes shall be visually inspected by the supervising engineer before being laid. A maximum of two hair line cracks (<0.25mm) and one small chipping damage (< 2 cm^2) may be allowed on any section of pipe (2.4m section). Pipe with cracks through the wall, exposed reinforcing steel, or damaged bells, spigots or joint grooves shall not be accepted.

For pipes that have been installed and the backfill completed, circumferential cracks less than 0.5mm and longitudinal cracks less than 0.15mm in width may be accepted at the discretion of the Manager Stormwater Assets. Cracks on installed concrete pipes should generally be assessed in accordance with the CPAA Publications Engineering Assessment and Acceptance Guideline for circumferential and longitudinal cracking.

4.13 MANHOLES, CATCHPITS AND OUTLET STRUCTURES

4.13.1 Position of Manhole

Manholes shall normally be provided at each change of direction or gradient and at each branching line and at a spacing of not more than 120 m for pipe lines up to and including 1200mm. For pipe lines larger than 1200mm, manhole spacing may be increased up to 200m. Manholes shall be made of precast concrete, except in special circumstances where the Engineer may approve cast in situ concrete manholes.

For pipes larger than 1200mm, precast saddle on manholes may be permitted subject to approval of the Development Engineer.

Manholes shall generally be placed where easy and safe access is available. Placing manholes directly under carriageways with busy traffic flows is generally discouraged. Manhole lids shall be clear of all boundary lines.

4.13.2 Standard Manholes

These are to be circular manholes with a minimum internal diameter of 1,050 mm (refer Papakura District Council Drawing SW9 and SW10) and are to be used on pipelines up to, and including, 600 mm diameter.

Precast manholes shall consist of centrifugally spun 1050mm, or larger diameter concrete pipes to Class 3 or greater standard. They shall have holes cast in the side for step irons.

All wall joints in manholes and the joint between the wall and concrete lid must be sealed with Bostick Titan Seal or an approved equivalent. The application shall be in conformity with the manufacturer's directions to provide a watertight and rootproof structure to the satisfaction of the Development Engineer.

Cast in situ manholes may not be used, except with the specific approval of the Development Engineer.

4.13.3 Deep Manholes

Where manholes are more than 5 m deep, they shall be specifically designed and shall incorporate intermediate landing platforms or grills in order to prevent a free-fall of more than 5 m. Refer Papakura District Council Drawing SS3 for typical detail.

4.13.4 Shallow Manholes

Where the stormwater line does not exceed 250 mm diameter, the depth to invert does not exceed 750 mm, the upstream grade does not exceed 10% and not more than two lines or connections enter the manhole (i.e. three including the discharge) the Development Engineer may approve of the use of mini-manholes.

Mini-manholes shall consist of a single length of centrifugally spun 675 mm diameter concrete pipe to a minimum of Class 3 standard, fitted with a standard cast iron frame and lid. The invert shall be fully benched as for standard manholes. Refer Standard Drawing SS2.

4.13.5 Stormwater Manholes on Larger Pipelines

Manholes on stormwater pipelines more than 600 mm in diameter and on smaller pipelines where the use of standard manholes is not suitable should be specifically designed.

For deep special manholes, it may be more economical to construct the lower portion to the required larger dimensions with the standard 1,050 mm diameter riser supported on a reinforced concrete slab on the lower large diameter chamber.
The use of fixed steel ladders instead of separate step irons is acceptable. Recessed steps without rungs may be permitted below pipe benching level, provided the lowest rung can be easily reached by a person standing at invert level. Typical details of fixed steel ladder and recessed steps can be found on Standard Drawing SS3.

On stormwater pipelines equal to or greater than 1200mm diameter, the spacing of manholes may be extended to up to 200 m and curvature on the pipeline may be permitted providing that joint deflections are within the limits of the manufacturer's recommendations. Any pipeline curvature is subject to specific approval by the Development Engineer.

Manholes on straight sections of stormwater lines of 1200m diameter and above may be constructed using offset intakes which may also be used in conjunction with bends, formed using epoxy mortar adhesive.

4.13.6 Hydraulic Flow in Manholes

In addition to the normal pipeline gradient, all manholes shall have a minimum drop of 20 mm plus 5 mm per 10º of the angle of change of flow within the manhole. Manholes on pipelines greater than 1 m diameter shall have the drop through the manhole designed to compensate for the energy lost due to the flow through the manhole at the design radius.

Surcharging of manholes is discouraged by Council. However, where unavoidable, surcharging up to a maximum surface level of 1.2m below the manhole lid will be accepted.

Where a change in pipe diameter occurs soffits shall be matched for stormwater drains.

4.13.7 Steps Irons, Steps and Ladders

All manholes other than shallow manholes shall be provided with approved galvanised steel step irons, steps or ladders in order to give reasonable access. Step irons shall be of the 'dropper' or 'safety' type such that a foot will not slide off them, and shall be spaced as shown on Papakura District Council Drawing SW16. All fittings used shall be hot-dip galvanised after fabrication.

Step irons and ladders should generally be located above the outlet branch of the manhole provided the outlet does not exceed 400 mm diameter. Where the outlet exceeds 400 mm diameter the step irons and ladders shall be located midway between the inlet and outlet.

4.13.8 Manhole Covers and Frames

Manhole covers and frames shall be of a design approved by the Development Engineer, manufactured from a strong and durable material. Typical examples of heavy duty, light duty, covers supplied in high quality grey or ductile iron, coated with a bituminous protective compound are illustrated in Papakura District Council Drawing SS3.

Non-rock type manhole covers and frames shall be used for manholes situated in trafficable areas for vehicles such as public roads.

The throats of all stormwater manholes shall be painted blue.

4.13.9 Drop Connections

Drop connections on stormwater manholes may be avoided by allowing pipes up to and including 300 mm diameter to have an open 'cascade' inside the manhole, provided that the steps are clear of any cascade. The maximum fall without a drop connection shall be 1.0m.

4.13.10 Manholes in Soft Ground

Where a manhole is to be constructed in soft ground, the area under the manhole shall be undercut down to solid ground (if practicable) and back-filled with suitable hardfill to provide an adequate foundation for the manhole base. Foundations of manholes in peat areas shall be specifically designed to the satisfaction of the Development Engineer.

Manholes in peat areas below the summer water table shall be designed to minimize leakage by using precast flanged bases and water tight joint seal.

4.13.11 Catchpits

Catchpits positioned within public roads shall be in accordance with requirements in 3.3.15.

Catchpits shall generally be constructed in accordance with R17, R18, R19, SW28 and SW29.

Catchpit spacing in public roads shall be designed to limit the spread of flow in a 10% AEP storm event to be:

- 2.0m at all local roads
- 2.0m at all sag points
- 1.5m at all arterial roads

The hydraulic capacity and capture efficiency shall be determined based on Chapter 4 of "Road Drainage Design Manual: (Mainroads, 2002) or "Highway Surface Drainage - A Design Guide for Highways with a Positive Collection System" (NRB: 1977).

4.13.12 Catchpit Lead Pipe

Catchpits should normally be connected to a manhole on the stormwater drainage system by 225 mm diameter pipes, except that if the stormwater drain is of greater diameter than 1200mm and a manhole is not conveniently located the catchpit lead may be saddled direct to that drain. A direct connection of the catchpit lead to a stormwater drain with a diameter between 600 mm and 1200mm diameter will only be permitted in exceptional circumstances, and at the Development Engineer's discretion. A typical catchpit design is shown in Papakura District Council Drawings R17, RR18, R19 and SW13.

Branch lines 300 mm diameter and smaller may be saddled on to pipelines 1.2 m diameter or larger, providing a manhole is supplied on the branching line within 50 m of the main line.

4.13.13 Inlet and Outlet Structures

Structures shall be constructed at the inlets and outlets of pipelines. Provision must be made for energy dissipation unless it can be demonstrated that the exit velocities and soil conditions are such as to make this unnecessary. The design shall ensure that:

1. The energy dissipating blocks shall be made and anchored into the apron in such a way that no structural damage will occur under the design peak discharge rate.
2. The number of dissipating blocks and their locations shall ensure that no flow can go directly from the end of the pipe without hitting at least one block.
3. When stormwater is discharged to a stream, the outfall structure shall be placed to direct the exit flow to merge with the flow in the stream at a sharp angle (<60º) to minimise local scour caused by turbulence. The apron level shall be set with a minimum fall above the low flow level in the stream to minimise the scouring energy. If fish passage through the upstream stormwater pipes is required, specific consideration shall be given to outfall design. The designer shall refer to

the ARC TP131 Fish Passage Guidelines for the Auckland Region (ARC, June 2000).

4. Inlet grilles shall be installed at inlet locations prone to blockage by debris or where entry of children into the stormwater pipes is of concern. The design of inlet screens and grilles will require careful consideration of accumulation of debris at the inlet and the adverse effects on the hydraulic capacity of the inlet.

In general, the inlet and outlet structures shall be designed and constructed in accordance with SW22 and SW23. Energy dissipaters and scour protection beyond the apron slab shall be designed in accordance with Chapter 13 "Stormwater Treatment Devices: Design Guideline Manual" (TP10, ARC)

Inlet and outlet structures (and other stormwater assets) must not display the manufacturer's name or any other advertising.

4.14 TESTING

The pressure testing of stormwater pipelines or branch drains will not normally be required. Acceptance will be on the basis of the quality of materials and the standard and accuracy of construction. However, testing may be required as set out in NZS 4452, if the Engineer has any doubt over the soundness of pipeline construction or if infiltration of groundwater is observed.

A CCTV survey of all new pipes will be required before vesting to Council. The CCTV survey of the pipe shall be undertaken in accordance with requirements in New Zealand Pipe Inspection Manual Issue 2.

Pipelines are to be laid true to design grade, without signs of internal ponding.

4.15 LANDSCAPE ENGINEERING STORMWATER DEVICES

4.15.1 General

This section covers the preparation, installation and maintenance of all new and existing engineered stormwater devices that have a designed landscape component (LESD). This includes, but is not restricted to, stormwater ponds, rain gardens, vegetated filters and swales.

4.15.2 Standard Landscape Specifications

The specifications in this section are supplementary to and take precedence over the other Council Standard Technical Specifications.

4.15.3 Mulch

All LESDs shall be mulched except for areas that are grassed or turfed. All mulch is to be approved by the Engineer prior to spreading. Specific LESD mulch applications are as follows:

Amenity Planting
Landscape planting between the drainage reserve boundary to the Upper Bank Zone shall only be mulched with bark or aged woodchip mulch where there is no possibility of surface ponding, flooding or mulch travel. Where surface ponding, flooding and mulch travel is possible within this area, biodegradable weed matting shall be used for all landscape planting.

Stormwater Ponds
No synthetic geotextile weed matting is to be utilized in the installation of the landscaping portion of landscaping engineered stormwater devices. However, synthetic geotextiles and other materials may be used, as applicable, to meet functional engineering requirements; for example, for inlets, outlets and high velocity channels.

Upper Bank and Lower Bank Zone Mulching
All plants shall be mulched with Council approved 0.5 metre diameter biodegradable weed mat rounds that shall be secured around plants, allowing adequate room around the stem for future growth. Firmly secure fabric mulch with wooden or other biodegradable pegs as per the manufacturer's instructions so that the fabric mulch does not detach from the soil, during inundation and high winds.

Marginal Zone Mulching
Council approved biodegradable weed mat is to be laid in a manner that the mulch will not uplift during inundation. Ensure that plants have adequate room around the stems for future growth.

Wet Zone Mulching
No mulching is required within the Wet Zone.

4.15.4 Rain Gardens

Rain gardens shall be mulched with Council approved biodegradable weed matting. River rocks (with a diameter of between 50mm and 150mm) in gabion mats (100mm to 300mm deep) may be permissible depending on stormwater engineering requirements and long-term maintenance requirements.

4.15.5 Swales

Roll-on turfed swales are not to be mulched.

Non-turfed swales are to be mulched according to the surface treatment and stormwater flow velocities, swale design, site location and long-term maintenance requirements. Mulching shall be installed as per manufacturer's instructions.

Vegetated swales planted with Carex sedges shall be mulched with biodegradable weed mat or secure biodegradable mat rounds.

Swales mulched with river rocks shall either be constructed with:

- Loose 50-150mm diameter river rocks on biodegradable weed mat; or
- River rocks of 50-150mm diameter encased in gabion matting.

4.15.6 Vegetated Filters

Vegetated Filters shall be mulched with biodegradable weed mat. Grassing and roll-on turfing does not require mulching.

4.15.7 Planting

All LESD landscaping shall be designed and installed according to Council and ARC requirements.

Grassing
All areas of engineered stormwater devices that are to be permanently grassed instead of vegetated with shrubs and/or trees shall be established according to the Council and ARC requirements.

During establishment and maintenance, ensure that no grass debris enters any water body or watercourse.

Stormwater Pond Planting
Permanent stormwater ponds shall be planted up as soon as possible after the completion of civil works construction. Where site conditions such as unstable soil structures require a more rapid groundcover than shrubs and trees provide, pond slopes shall be stabilised with grassing first and a Staged Pond Planting is permitted as detailed in this code.

Staged Pond Planting Stage 1: Grassing
Pond banks shall be prepared and sown with grass seed to establish rapid ground stabilization.

Grassing and Turfing Specifications
Where ponds are to be established in nitrogen-deficient soils and at the Engineers discretion, the seed mixture shall be:

- Annual Rye Grass 150 kg/ha
- Sweet Clover 100 kg/ha

All seed shall be certified and less than 12 months old at the time of sowing. The Ryegrass component is to be certified as having greater than 80% live endophyte content. The Engineer may prohibit the use of seed that has deteriorated because of wetting, fertiliser burning etc.

The site shall be grassed for at least three months and meet establishment requirements for sown areas prior to landscaping.

Staged Pond Planting Stage 2: Landscape Planting
Stage 2 Planting shall occur within the Council planting season (2 April to 30 September) once Stage 1 sown grass has established. Ensure that no weed species exist throughout the site. Where weed species need to be eradicated either carefully spot spray and/or hand-pull in such a manner that erosion is minimised and surrounding groundcover remains undamaged. The sown grass groundcover shall be spot sprayed to 0.50m diameter for each location where individual plants are to be planted 4 weeks prior to planting, ensuring that the established grass between spot sprays remains undamaged. Maintain sprayed areas so that no new weed growth

exists at time of planting. Install and establish planting and mulching in accordance with Council and ARC requirements.

Rain Gardens and Vegetated Filters
Rain gardens and Vegetated Filters are to be planted up according to Council and ARC requirements.

Swales
Turfed swales shall be prepared, established and maintained as per Council and ARC requirements. Both during and post-establishment, the height of the turf shall be consistently maintained at least fortnightly to designed stormwater engineering requirements. Turf shall be of a drought-resistant hard-wearing rye-grass based variety with no weeds species. Swales planted with Carex species shall be planted according to Council and ARC requirements.

Spraying and Weed Control
Ensure that no spray enters any water body or watercourse. In respect to stormwater ponds, where weed species exist both on and within 2.5m adjacent to the normal standard waterline, weeds shall be controlled by either hand-pulling or weed-eating in such a manner that no debris enters any water body or watercourse.

Tree Staking and Protection
Trees shall be tied to two stakes on opposite sides to the tree using biodegradable flexible ties made from either cloth or flax. The ties are to be positioned one third up the tree's main stem and with enough give to move in the wind to ensure adequate trunk development.

4.15.8 Maintenance Requirements

The Developer shall be responsible for the routine maintenance of the landscape planting works including weeding, mulching, replacement of plants and watering during the defects liability period.

4.15.9 Defects Liability Period

The planting defects liability period for all LESDs, except Stormwater Ponds, shall be two (2) years from practical completion and Council acceptance of landscape planting works or upon release of any implementation bond held for uncompleted landscaping, except when planting is carried out between October 1 and April 1 the defects liability shall be extended for an additional 6 months.

Where stormwater ponds are to be permanently grassed, the defects liability period is a minimum 6 months if sown between April 2 and September 30. If sown between October 1 and April 1 the period is extended for a further 6 months.

Where a stormwater pond is planted directly after completion of civil works construction, the landscaping defects liability period shall be a minimum 12 month period, except when planting is carried out between October 1 and April 1 the defects liability shall be extended for an additional 6 months.

Where a stormwater pond planting is implemented according to the Staged Pond Planting, the Stage 1 defects liability period will extend for a minimum of 6 months or until such time as the Stage 2 planting is instigated.

The stormwater pond Stage 2 defects liability period shall be a minimum of 12 months, except when planting is carried out between October 1 and April 1 the defects liability shall be extended for an additional 6 months.

4.15.10 Weed Free Requirement

The permissible weed regime within an LESD is:

- No plants that are mulched with Council approved biodegradable weed matting, are permitted to have weeds within the mulched area.
- All LESDs, other than stormwater ponds, shall have no individual weed larger than 100 mm wide x 100 mm high. Furthermore no weeds that are 100 mm wide x 100mm high or greater in size shall exceed more than five per square metre. Neither perennial grass weeds nor plant pests recognized by the Auckland Regional Council shall be accepted at any size.
- Grasses sown as part of landscape planting are permitted. However, no other perennial grass weeds will be accepted.
- Stormwater Ponds shall have no individual weed larger than 300 mm wide x 300 mm high. Furthermore no weeds that are 100 mm x 100 mm x 100 mm or greater in size shall exceed more than 5 per square metre. Neither perennial grass weeds nor plant pests recognized by the Auckland Regional Council shall be accepted at any size.

4.15.11 Defects Liability Period Inspection

The Contractor, after completing all proposed works, shall advise the Engineer at least seven working days prior to the proposed commencement of the defects liability period and shall be available for a joint pre-defects liability period inspection.

4.15.12 Defects Liability Period – Final Inspection

The Contractor at the end of the required defects liability period shall advise the Engineer at least 7 working days prior to the proposed commencement of Council acceptance of the asset and its ongoing maintenance.

PART 5: WASTE WATER

Contact:

United Water Papakura
116 Great South Road
Papakura
Auckland

T 09 2962626
E uw.papakura@uwi.co.nz
W www.unitedwater.co.nz

PART 6: WATER RETICULATION SYSTEM

Contact:

United Water Papakura
116 Great South Road
Papakura
Auckland

T 09 2962626
E uw.papakura@uwi.co.nz
W www.unitedwater.co.nz

PART 7: PARKS AND RESERVES

7.1 SCOPE

Where reserves are provided this standard sets out the requirements for such reserves and sets minimum requirements for landscape plans, fencing and planting.

This standard is intended to ensure that the development of parks and reserves is to a standard that will not create future maintenance problems and will be compatible with other reserves in the district.

Consultation with Council's Community Assets Manager at the preliminary planning stage, or earlier, should be undertaken to determine any specific requirements.

7.2 GENERAL

7.2.1 Landscape Plans

Landscape plans shall take account of Council's:

- Open Space Strategy
- Esplanade Reserve Strategy
- Tree Policy
- Pahurehure Inlet Management Plan.

Landscape plans shall be submitted with other engineering plans of development for approval. The plans shall show the proposed finished levels of the reserves, and any proposed planting, features, bins, furniture and any drainage that is to be installed.

Landscape planning shall consider both the short and long term maintenance requirements for the areas to be planted.

Landscape planning is to consider the whole of the adjacent area and not just the immediate area of the development. It must fit in with adjacent developments and any future stages of the proposed development and adjacent land.

7.2.2 Trees

Where possible existing trees should be maintained. Where existing trees are to be maintained, current best practice supported by a qualified arborist's advice shall be applied to protect them from damage during development.

Trees identified for protection shall have a protection zone extending to one metre beyond the drip line.

Trees that may become invasive in water courses should not be planted. These include, but are not limited to, Pussy Willow (Salix reinhardtii) and Black Alder (Alnus glutinosa).

Council's Community Asset Manager must be consulted before trees are planted.

7.2.3 Walkways

Walkways shall comply with the National Guidelines for Crime Prevention Through Environmental Design (CPTED) and current best practice.

Walkways shall have concrete paths installed that shall comply with the requirements of this code for thickness and reinforcing. Any variation in finish e.g. exposed aggregate, cobbles etc will require the prior approval of Council.

The maximum gradient on walkways shall where possible comply with the requirement of the Disabled Persons Act. Where possible steps should be avoided.

Footpaths shall be laid with sufficient fall and drainage to ensure that stormwater does not pond on the path.

Where being used as access to maintain reserves, concrete shall be thickened and reinforced to allow for maintenance equipment.

7.2.4 Fencing

Any reserve with a road frontage in excess of 5m long shall have an appropriate fence composed of materials that will allow visibility through to and into the reserve and not compromise the safety or security of park users.

The fence must comply with National Guidelines for Crime Prevention Through Environmental Design in New Zealand (CPTED), part of the New Zealand Urban Design Protocol. All reserve fencing design must be approved by the Manager Community Assets prior to installation to ensure that it meets the above guidelines.

Fencing may include:

Open weave trellis or wire/grille/pool fencing or any other ‘permeable’ (i.e. see through) design to a height of 1m with open grill/pool fencing style above 1m in height to a maximum of 1.8m.

Bollards and/or planting can be in front of the fence, planting can alternatively be placed behind. Planting must be spaced according to the guidelines and be comprised of species that will not provide opportunity for the concealment of people.

Surveillance and sightlines must be maintained so that areas of the reserve are not cut off or shielded by solid fencing.

Solid wall fencing is only permitted to a height of 800mm. Above that height, other design elements such as wire, pool fencing, open trellis must be used.

CPTED guidelines are available from Council’s Community Services department.

7.2.5 Drainage

Sufficient stormwater drainage shall be provided to ensure that water does not pond excessively on the reserves and that the reserves are able to be mown throughout the year.

7.2.6 Park Furniture

Park furniture shall be robust and shall not be installed without prior Council approval. All furniture shall be treated with a Council approved graffiti guard.

Playground equipment shall comply with NZS 5828 "Specification for Playground Equipment and Surfacing" and the "New Zealand Playground Safety Manual", and meet Council's levels of service guidelines.

Developers must provide the Parks Manager of Papakura District Council with a list of all features, (furniture, objects and assets which are installed and which will become publicly owned assets) in accordance with Appendix E. This will include, but not be limited to, the attributes and values as follows:

- Feature type.
- Material composed of.
- Location in accordance with NZTM (NZGD 2000) datum.
- Value when installed.
- Make/model/supplier/manufacturer.
- Number of items.
- Length/dimensions.
- Area fixing method.

An As-Built plan showing the layout and placement of all features must also be provided.

7.2.7 Street Berm Planting

Proposals for street berm planting will require a detailed plan that considers the location and possible effects on underground services, effects on sightlines, long and short term maintenance costs and will require the prior approval of Council.

7.3 SITE PREPARATION

All irrigation and drainage works, utilities installation, signs or landscape structures shall be completely installed and approved prior to planting.

Sawcutting of existing seal where required shall be undertaken between 250mm to 300mm from the back of the kerb. The cut line shall be parallel to the kerb lines wherever possible. Small radius curves shall be cut using a series of short incisions to approximate as best as possible the curve arc.

7.3.1 Excavation of Planting Areas

Excavation shall be carried out where necessary to achieve either of the following required soil profiles where depths indicated are post consolidation:

(a) Landscape Bedding (refer to Figures 1 and 2):
- 150mm of base soil
- 150mm composite topsoil, being 70% topsoil and 30% manure or compost incorporated (refer below)

- 75mm of bark or 10mm biodegradable fabric mulch (refer to Clause 7.8) (to be maximum of 25mm below top of kerb)
- Total depth of excavation 400mm below top of kerb.

(b) Annual Bedding (refer to Figure 3):

- As per the Landscape Bedding profile
- Total depth of excavation 325 mm below top of kerb

All waste material shall be removed from site and disposed of to an approved facility or site.

Exposed subgrade shall be trimmed and levelled so that no part of the subgrade shall be above the required depth of cut.

The subgrade of the proposed planting area shall be firm but free draining. If required by the Development Engineer the subgrade strata shall be made permeable by the insertion of vertical holes to permeable layers, by scarifying of the surface to ensure free draining through the underlying material, or by undercutting the existing subgrade to a greater depth than specified. In this case, the unsuitable material shall be removed and replaced by imported pit sand to top of subgrade level.

Figure 1. Option (A) Planting Area - Topsoil & Mulch Profile, post-consolidation, for slopes less than 1:3 gradient. (Refer to clauses 2.1 and 7.0.)

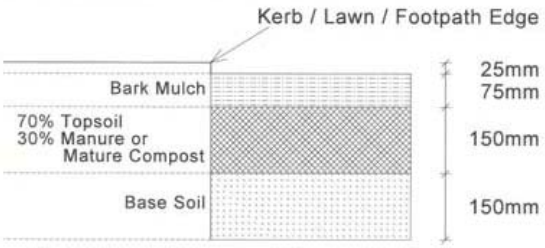


Figure 2. Option (A) Planting Area - Topsoil & Mulch Profile, post-consolidation, for slopes more than 1:3 gradient. (Refer to clauses 2.1 and 7.0.)

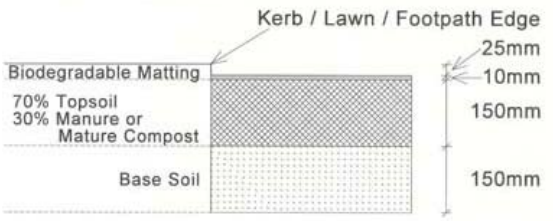
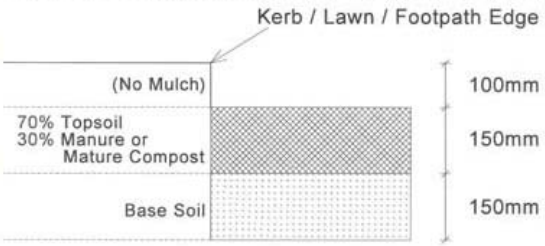


Figure 3. Option (B) Annual Bedding Planting Area - Topsoil Profile, post-consolidation. (Refer to clause 2.1.)



In areas of new planting, base soil (either 2nd grade topsoil or pit sand) shall be placed evenly over the prepared subgrade and consolidated to a depth of 150mm. The sand/soil shall be free of debris and perennial weeds. No sand/soil shall be placed without the Development Engineer's prior consent.

In all sites, except natural gully systems, where the slope gradient is steeper than 1:3, it is preferable that the embankment is either scarified or grooved on an angle to a depth

of 200mm, from the top of the bank to the base. This assists topsoil adhesion and prevents separation of the top 150mm topsoil from the base material due to gravity and/or glazing and planting of base material.

Should site conditions, such as gradient or compaction, prevent scarifying, the embankment sub-base shall be benched to develop an adequate topsoil profile. The horizontal benching depth is dependent on the slope gradient.

7.3.2 Soil for Planting Areas

Topsoil, either imported or existing on site, shall be a loam soil of good quality, free draining, free of perennial weeds and debris and capable of sustaining the required plant growth. All topsoil shall be inspected at its source and shall not be placed without the Engineer's consent. All topsoil must be free from contaminants.

Soil importation and stockpiling must meet District Plan rules in terms of volume. Stockpiles of imported or site topsoil to be used in planting areas shall be left to grow vegetation and sprayed by the contractor to eliminate perennial weeds prior to their seeding and prior to the soil's use. A knock-down systemic herbicide without long term residues shall be used (see Clause 7.11). Treated soil shall not be placed without the Development Engineer's consent. If, after placing the topsoil and prior to any final cultivation, there is evidence of vegetation growth, the surface shall again be sprayed by the Contractor with a knock-down systemic herbicide. Areas so treated shall not be planted for at least two weeks.

All new planting areas on in-situ topsoil shall be deep ripped to 300mm prior to planting. Heavily compacted soils shall be deep ripped to 600mm. If in the Development Engineer's opinion, at time of planting, the soil has consolidated to a density unsuitable for planting out, re-cultivation of the soil to a depth of 150mm shall be undertaken by the contractor.

All new planting areas shall be filled with topsoil or excavated (as appropriate), to be 100mm below adjacent paving, kerbs or lawns after cultivation and reasonable consolidation.

Prior to planting, all planting areas shall be cleaned of rubbish, stones, unwanted vegetation and other debris.

At planting, all planting areas shall have a minimum uniform soil moisture level of greater than 50% to 200mm depth.

Soil Laboratory Testing

When an area of 500m^2 or more is to be planted with shrubs and/or trees, the topsoil shall require nutrient laboratory testing. The minimum number of sample sites depends on the following criteria:

(a) If the topsoil has already been installed on site or existing insitu topsoil is being used for planting, a minimum of 10 soil samples shall be taken throughout the site.

(b) If the topsoil has yet to be installed then a minimum of 3 soil samples shall be taken at its source, ensuring that the same topsoil tested is installed on the site after Council has approved its use.

Soil samples shall be taken as per sampling instructions provided by the soil testing laboratory.

The laboratory results and a plan indicating sample site locations shall be provided to Council prior to planting. Planting shall not proceed without Council soil test approval. Council reserves the right to undertake further topsoil sample testing prior to soil test approval should it be deemed necessary.

Where sample results are beyond acceptable parameters, the topsoil shall be modified to ensure that it aligns within these parameters or another conforming topsoil source shall be identified to be used for planting. Soils with a high pH level may require Extractable Aluminium testing at Council's discretion.

The following soil testing is required per sample:

Soil Component	**Acceptable Parameter**	
pH	5.8 – 6.3	(dependent on plant species requirements)
Phosphorus	30 – 80	ug/mL
Potassium	0.5 – 1.0	me/100g
Calcium	6 – 12	me/100g
Magnesium	1 – 3	me/100g
Sodium	0 – 0.5	me/100g
CEC	12 – 25	me/100g
Base Saturation	50 – 85	%
Volume Weight	0.60 – 1.00	g/mL
Available Nitrogen (15cm depth)	150 – 250	kg/ha
Organic Matter	7-17	%
Total Nitrogen	0.2 - 0.5	%

In made-up ground and where poor plant growth has been experienced previously, the topsoil may require laboratory testing for areas smaller than 100m^2, at Council's discretion.

7.4 PLANT MATERIALS

All plants shall be supplied true to the species and grades specified on the approved landscape plans and shall comply with the Council's tree policy. All street trees, unless specified otherwise, shall be of a minimum grade of 2.0m with a 30mm calliper. Other tree grades shall be supplied as follows:

1.5m - 2.5m specimens shall have a calliper of 30 - 50mm
2.5m - 3.5m specimens shall have a calliper of 50 - 70mm
3.5m - 5m specimens shall have a calliper of 70 - 100mm

All other stock shall be of minimum pb3 grade for groundcover and pb5 grade for shrubs.

All plants to be advanced specimens for their grade and to be well furnished and rooted relative to container size.

No substitution of species or grade shall be made without the written approval of the Development Engineer. If species or grades specified are unobtainable, the Development Engineer may approve alternatives. Smaller grades may require an increased planting density and numbers, which shall be at the Contractor's expense.

All plant material supplied shall be clearly labelled stating the plant's Latin name and the supplier's name, (one label per plant group planted). These labels shall be removed on completion of planting.

The Contractor shall give the Development Engineer not less than five days notice of dates upon which plants are to be delivered on site, so that arrangements can be made for quality inspection and confirmation of identification of plant material.

Plants shall be well branched, symmetrical and of typical habit for the species. All plants shall be nursery stock of good form, healthy and vigorous with strong fibrous root systems and free of all pests and diseases.

All trees shall be supplied with the central leader intact - no pruning of the central leader shall have taken place. All torn or damaged roots shall be pruned before dispatch. All stock shall be well rooted but not root bound. Open ground stock shall be well-wrenched. All root balls and containers shall be free of all weeds. Plants shall be well 'hardened –off' prior to supply.

The Contractor shall ensure that all plants and their roots shall be maintained in a moist environment, protected from adverse conditions such as drying winds, frost or water logging. All roots must be covered during transit and storage to prevent desiccation or damage.

7.5 INSTALLATION OF PLANTS

All of the planting shall normally be undertaken between April 1 and October 1. Planting for deciduous stock shall take place between 1 June and 15 September. Planting not undertaken in this period is subject to additional maintenance requirements.

All plants shall be planted on the day of delivery to the site. Plants shall be planted in the locations shown on the plans and in accordance with good horticultural practices. Unless otherwise indicated on the plans all plants shall be planted in a random pattern at the densities specified.

Planting holes shall be excavated, a minimum of 150mm wider and 150mm deeper than the root ball. For large trees the planting hole minimum dimensions shall be:

1.5 - 2.5m trees: 300 x 300 x 300
2.5 - 3.5m trees: 750 x 750 x 500
3.5 - 5.0m trees: 1m x 1 m x 500

The base of the planting hole shall be forked to a minimum depth of 100mm and any stones over 50mm diameter or poor quality soil shall be removed from the hole. The sides of the planting hole shall also be loosened, and the surrounding ground to two times the root ball diameter to be 'forked' over to reduce compaction.

Where topsoil is unsuitable for backfilling the Contractor shall use imported or modified top soil for backfilling. The imported topsoil shall be a free draining loam of a quality complying with that specified in Clause 7.3.2 and subject to inspection prior to placement. Modified backfill soil shall consist of a homogenous mixture of the following:

- 7 parts by volume of good quality, friable topsoil from the site or imported.
- 3 parts by volume of approved compost.
- 2 parts by volume of coarse river sand.
- Appropriate levels of fertiliser where specified.

The Contractor shall not plant into waterlogged soil or holes that are full or part full with water. If the water table is high and the Contractor cannot disperse the water from the hole, the Contractor shall consult the Engineer as to whether planting can continue.

All plant containers or wrapping and if necessary any root bound roots shall be removed prior to planting. Leaves and branches shall be pruned to assist plant establishment if necessary. Generally, the nursery soil level is clearly identifiable on the main stem of the plant and replanting should not exceed this level.

The hole shall first be backfilled with 150mm of consolidated soil or soil mix, mounding the soil in the centre to aid even spread of the roots.

The plants shall be placed in the hole ensuring that the final soil level is equal to or not exceeding 10mm above the nursery soil level and at an appropriate depth to ensure sustained growth. Roots shall be spread evenly to their natural extent without touching the sides of the hole, or being distorted in any way. Bare rooted material shall be shaken to ensure even root spread.

For trees, the hole shall be backfilled with topsoil or soil mix in 150mm layers, firming each layer. For container plants and shrubs, the hole shall be filled to half its depth and firmed and then completely filled and firmed again. Upon completion of backfilling the plants shall be well watered in.

All road reserve planting installation is to comply with 3.2.8 – Street Landscaping.

7.6 IRRIGATION

During installation and establishment, the contractor shall ensure that soil in all planting areas is moist enough to maintain active plant growth throughout the growing season (September – May). To achieve a high level of site presentation or in areas of annual bedding display planting, irrigation systems may be required to achieve this. Where an irrigation system is required to be installed, 'Toro' brand or a similar approved brand shall be used. The system shall be capable of providing a minimum soil moisture level of 50% to 200mm depth, throughout the planted areas or within the drip line of trees

specified. It shall be capable of fully re-wetting the root zone to 200mm depth when the irrigation is applied; and shall be fully automated to operate between 1am and 6am when moisture levels drop below 50%.

7.7 FERTILISER

Generally, some form of fertiliser shall be applied to planting. For shrubs and trees, all fertiliser shall be well mixed with the backfilled soil. For bedding or groundcover all fertiliser shall be well mixed with the site topsoil prior to planting. Fertilisers shall be either an approved pelletised natural or organic fertiliser or an approved synthetic fertiliser.

The following synthetic fertilisers are acceptable unless alternatives have been approved:

- For bedding or perennial (groundcover) planting – 'Nitrophoska Blue' at 100g/m2
- For shrub planting – 'Mag Amp' at 40g/shrub
- For tree planting – 'Mag Amp' at 80g/tree

An exception to these is for Proteaceous species and ferns which should on no account be fertilised with Phosphate (P) containing fertilisers.

7.8 MULCH

Where indicated in the schedule and on the plans, the Contractor shall provide mulching to newly planted areas. In addition, all individual trees including street trees shall be mulched to a radius of 500mm.

Flat Site Mulch
On sites flatter than 1:3, bark mulch shall be spread evenly to minimum depth of 75mm and maximum of 100mm except that around tree trunks a slight hollow shall be left. The mulch shall be either coarse or fine, untreated, shredded pine bark as scheduled, and shall be approved by the Engineer prior to spreading. The bark mulch shall be clean and free of soil or sawdust. Coarse bark should have an average diameter of 50mm and with no pieces longer than 100mm. Fine bark should have no pieces longer than 40mm and be evenly graded. Coarse bark is appropriate to most locations. Fine bark may be specified by Council in Commercial zones, or for other specified locations.

All care shall be taken in placing the bark mulch so as to protect the plants and any irrigation system. All damage to the plants or irrigation system shall be rectified at the Contractor's expense.

Steep Site Mulch
On slopes steeper than 1:3, mulching for weed control shall consist of approved matting with the following criteria:

(a) The matting consists of biodegradable mulching fabric or material without synthetic geonet or synthetic geotextile content.

(b) It shall be installed according to manufacturer's instructions prior to planting, ensuring that the mulch will not uplift due to inundation or wildlife exposure (from, for example, Pukeko birds).

(c) The mulching fabric shall have a minimum 24 month life expectancy and be fully biodegraded into soil within 6 years.

At the Engineers discretion, mat rounds may be used instead of matting.
These shall be a minimum 500mm diameter and have the same characteristics as the matting.

On steep slopes with erosion issues that are to be planted, a biodegradable netting with no geotextile or geonet content shall be used at the Engineer's discretion. The netting will have an expected lifespan of at least 36 months.
This may be placed on top of the mulch matting and shall be installed according to manufacturer's instructions. The netting is not intended to suppress weeds and should be used in conjunction with mulch matting or rounds.

7.9 STAKING AND PROTECTION

Newly planted trees shall be firmly staked and tied as follows:

- 1.5 - 2.5m trees shall be staked with 2 no. 50 x 50 x 1.8m stakes with at least 1m exposed
- 2.5 – 5.0m trees shall be staked with 2 no. 75 x 75 x 2.4m stakes with at least 1.5m exposed, or with a system of ground anchors approved by the Engineer and specified in the landscape plans.

All street trees shall be staked with 2 no. 50 x 50 x 1.8m stakes.

All stakes shall be rough sawn Pinus H5 treated. Stakes shall be placed with at least one third of their length in the ground.

Two flexible ties per stake shall be attached. Ties shall be tensioned to avoid chafing of the tree against the stakes. All ties shall be fixed to the stakes. Ties shall be of a type approved by the Engineer prior to tying.

Newly planted areas shall be protected from any possible construction or other damage. To ensure protection for the duration of the site works, the Contractor shall if necessary, provide and maintain a 1m minimum height barrier around the plants.

Similarly, during planting, existing structures, turf, other planting, or irrigation system shall be protected by appropriate means from possible damage.

7.10 PRUNING

Ongoing pruning during the contract maintenance period shall concentrate on producing good plant form, ground coverage, removal of spent flowers, healthy growth, preventing plants smothering other planting, keeping access ways clear of growth and maintaining visibility.

Trees shall be pruned up to provide good visibility for vehicles and pedestrians at all times (long term, trees should have a clear stem to 2.4m). Pruning should be carried out in accordance with acceptable modern arboricultural practices.

Shrubs shall be pruned down to 450mm height maximum, for good visibility at intersection and other visibility splays.
Pruning of shrubs and groundcovers shall use techniques which maintain the natural form and habit of the plants. Pruning shall avoid "hedging" techniques which create strong visual lines and detract from the natural texture and form of the plants. Groundcover plants shall be pruned by undercutting at the edges.

Planting designed as hedges shall be clipped only after Spring or Autumn growth flushes. Hedges grown for flowers shall be clipped only after completion of flowering. Hedge trimming shall be carried out in a way that will promote even growth to the specified height and width.

All prunings shall be removed from the planted areas and the site, to maintain these in a clean and tidy condition.

7.11 CHEMICAL APPLICATIONS (WEED & PEST CONTROL)

All chemical application on planted areas shall be carried out by qualified, trained personnel and according to the Growsafe Code of Practice for Safe Use Pesticides and Herbicides, NZS 8409, 'Management of Agrichemicals' and any manufacturers' directions.

All spraying operations shall be carried out in windless, dry conditions, when rain is not imminent for at least 12 hours and at times which minimise possible hazards or disruption to the public, animals or other beneficial fauna. Care shall be taken to prevent spray drifting onto non-target areas or plants and comply with notification requirements as required by any local register of 'no spray zones' or Regional Council requirements.

Herbicides may be used to control weeds or excess grass growth over structures, surfaces or into planting areas. Approved herbicides are:

- Glyphosate with Codacide oil or Pulse Penetrant for general use.
- Glyphosate + "Versatil" for persistent perennial weeds.
- Tordon Brushkiller or Escort for spot spraying of woody weeds only.

All use of any other herbicides shall be first approved by the Engineer.

All trees in grassed areas shall have a weed release spot spray applied between four and six months after planting. General weed control shall be carried out whenever necessary to maintain the planting weed-free.

Chemical weed control in planting areas shall be kept within the edge of the planting beds, within a maximum of 500mm of tree trunks, within 50mm of the edge of any undefined mulch surface, and within 50mm of any posts or the base of any landscape structures.

Pesticide use shall be effected to the minimum level required for healthy plant growth to be maintained. All pesticides shall be approved for use by the Engineer. Pesticides used shall be selected for the lowest oral and epidermal toxicity rating possible and shall be types which pose a minimum risk to bees or other beneficial insects.

7.12 MAINTENANCE REQUIREMENTS

The Contractor (or Developer) shall be responsible for the routine maintenance of the landscape planting works including weeding, mulching, replacement of plants and watering during the defects liability period.

7.12.1 Defects Liability Period

The planting defects liability period shall be two (2) years from completion and acceptance of the landscape planting works or upon release of any implementation bond held for uncompleted landscaping, except that if planting is carried out between October 1 and April 1 the defects liability period shall be extended for an additional 6 months.

During and at the end of the defects liability period, the following minimum standards are required:

- all topsoiled areas prior to planting and mulching shall be weed-free
- all planted areas shall be kept weed-free
- all planted areas including street trees shall be mulched with clean fabric, fibre or loose
- fill mulch
- all trees and other planting shall be vigorous and healthy, free of disease and free of dead growth or dead flowers
- all planted areas shall be moist to at least 200mm depth
- planting is becoming well established. Any plants failing during this period shall be replaced to the specification, to ensure adequate establishment of the planting
- plant growth shall be trimmed to the extent and height required for any visibility splays
- all tree stakes and ties shall be intact and correctly installed.

7.12.2 Weed Free Requirement

At the end of the defects liability period, no individual weed must be larger than 30mm x 30mmx 30mm high. Furthermore no weeds that are at least 10mm x 10mm x 10mm in size shall exceed more 5 per square metre. Furthermore, no perennial grass weeds will be accepted.

7.12.3 As-Built Plans

The Contractor shall supply one copy of the As-Built plans and record any variation from the approved landscape plans and this specification.

Refer to As-built's section Appendix E.

7.12.4 Defects Liability Period Inspection

The Contractor, after completing all proposed works, shall advise the Community Assets Manager of Papakura District Council, at least 7 working days prior to the proposed commencement of the defects liability period and shall be available for a joint pre-defects liability period inspection.

7.12.5 Defects Liability Period – Final Inspection

The Contractor at the end of the required defects liability period shall advise the Community Assets Manager of Papakura District Council, at least 7 working days prior to the proposed commencement of Council acceptance of the asset and its ongoing maintenance.

7.13 GRASSING AND TURFING

7.13.1 General

This section covers the preparation and sowing of any new grassed areas or those requiring reinstatement, or turfing of such areas. It includes berms, lawns and banks.

7.13.2 Preparation for Sowing or Turfing

Grassing and fertilising shall be carried out over all existing grassed areas disturbed by contract activity and other specified areas which may require reinstatement. In existing grassed areas, excessive compaction of the subsoil shall be relieved by subsoiling or similar as required, to achieve satisfactory long term growing conditions.

All topsoil removed to permit contract works to be carried out shall be stockpiled for reuse.

All new grass areas shall be built on subgrades prepared to a CBR of not less than 5 and no greater than 7. A minimum 75mm layer of clean, friable peat loam or sandy loam topsoil, free of all perennial weeds, stones and rubbish shall be placed on the subgrade. If the subgrade has been backfilled with sand or if the existing subgrade material is of a sandy nature then the 75mm topsoil shall be of a heavier silt loam.

The topsoil shall be lightly compacted or consolidated, and may be laid proud of adjoining features (such as kerb & channel, path, crossings etc) by not more than 25mm to allow for settlement, provided that it does not cause water to pond on any footpath or vehicle crossing area. All finish levels shall be those specified on the plans or to a 2-2.5% slope. New areas shall be neatly contoured into adjoining grassed areas. The top 25mm of topsoil shall have a loose tilth. No soil shall be cultivated or handled when the moisture content is at a level where soil structure damage will result.

Perennial weeds shall be sprayed with Glyphosate plus "Versatil", if clover, thistles, etc are a problem, according to manufacturer's instructions and at least 14 days before cultivation. All stones, rubbish and other foreign materials shall be removed from the

areas to be grassed, and the whole area rotary hoed to a depth of 150mm or such lesser depth of topsoil as may be approved by the Engineer.

7.13.3 Fertilisers

All fertilisers shall be delivered to the site immediately before they are required for spreading and shall be thoroughly mixed on the site. The Engineer may prohibit the use of any fertilisers which have deteriorated because of interaction, wetting, etc. Fertilisers shall be lightly harrowed into the topsoil, 2-3 days prior to seed sowing, at the following rates:

• 30% Potassic Superphosphate	150 kg/ha	(15g/m2)
• Sulphate of Ammonia	50 kg/ha	(5g/m2)
	200 kg/ha	

This shall be followed one month after sowing, with an application of the following:

- Di-ammonium Phosphate (DAP) 100 kg/ha

7.13.4 Sowing

With the exception of the New Zealand Browntop component, all seed shall be certified and less than 12 months old at the time of sowing. Ryegrass component to be certified as having greater than 80% live endophyte content. The Engineer may prohibit the use of seed which has deteriorated because of wetting, fertiliser-burning, etc.

Seed mixture to be:

- NZ Browntop 10 kg/ha (approximately 5%)
- High endophyte Turf Rye grass 210 kg/ha (approximately 95%).

On large areas, the seed shall be "check" sown in at least two directions to ensure an even spread and covered by brush harrowing. The surface shall then be rolled with a suitable flat roller.

On small areas, grass seed shall be evenly applied to the prepared surface and raked thoroughly into the soil so that little seed remains exposed.

7.13.5 Establishment of Sown Areas

The Contractor shall ensure that the newly established grass is protected from damage by pedestrian and vehicular traffic until such time as the grass growth has reached a self-sustaining state.

The Contractor shall be responsible for watering the grassed areas as required, to achieve an efficient germination of the seed and maintain satisfactory growth throughout the Maintenance Period. Watering shall commence when root zone moisture is depleted to 50% and shall ensure full re-wetting of the root zone to 200mm depth.

During the establishment, the Contractor shall maintain the newly grassed areas as follows:

(a) Upon the grass reaching 100mm in height, it shall be cut to 75mm high and maintain at this height for 4 to 6 months (maintaining two-thirds grass length) until established.

(b) For subsequent mowings, the mowing frequency shall be governed by growth rate. Minimum grass height to be 20mm - maximum grass height to be 30mm.

(c) The turf shall be maintained free of all broadleaf weeds.

(d) Areas where there has been a poor strike of grass shall be either re-cultivated and re-sown or undersown at the Contractor's expense.

(e) Upon completion of mowing, all grass clippings shall be collected and removed from all sown grass areas except non kerb-and-channelled berms. All clippings shall be removed from adjacent hard surfaces.

(f) Edges of all sown grass adjoining cultivated gardens, borders, hand paving, sealed surfaces or landscape structures shall be trimmed to the edge or controlled by herbicide to within 25mm of flat surfaces or 50mm of vertical structures. Grass shall not be allowed to encroach over flat, sealed or paved surfaces by more than 25mm.

7.13.6 Turfing

The turf shall be of good quality, free of weeds and pests, with an even thickness of approximately 20mm, 450mm wide and of a consistent length. The constituent grasses of the turf should include Browntop and Fescue to provide grass of a close texture of even density and green in colour, i.e. "Readylawn" or similar approved by the Engineer. The turf should be sufficiently fibrous for turves to hold together when handled but excess fibre or thatch is undesirable.

Turf should be packed to avoid drying out in transit. In hot weather it shall be sprayed with water and covered with hessian as required. Turf shall be delivered to the site within 24 hours of lifting and shall be off-loaded by hand unless arranged on pallets for mechanical handling. Any turf permitted to dry out shall be rejected when, in the opinion of the Engineer, its survival after placement is doubtful. All turf should be laid immediately after delivery to site. Where this is not possible, the turves shall be unloaded and stacked on clear ground to maximum height of one metre and suitably protected.

No turf shall be laid in exceptionally hot dry weather, or in exceptionally wet or frosty soil or weather conditions, nor shall any turf be laid until the topsoiling has been satisfactorily completed by being brought to an even tilth and firmness.

Turf shall be handled carefully to ensure minimum breakage to prevent soil dropping from the roots. The turf shall be laid from planks working over turves previously laid.

The turves must be thoroughly watered until the turf mat and top 50mm of soil is wet. After allowing a "soaking in" period the turves shall be lightly and evenly firmed with a wooden tamper so that the underside of the turf mat and the wet soil surface are thoroughly bonded.

The finished level of the turf shall conform to the levels indicated. Where the turf meets paths, mowing strips etc the finished level shall be 12mm above. Any inequalities in finished levels owing to variation in turf thickness or uneven consolidation of soil shall be adjusted by raking and/or packing fine soil under the turf, not by topdressing the lawn surface.

7.13.7 Establishment of Turf

During the establishment the Contractor shall maintain the turf as follows:

(a) Prevent any pedestrian traffic until grass is well established and uniformly covered with a strong sward of grass.

(b) Apply lawn fertiliser e.g. "Readylawn Food", at a rate according to manufacturer's instructions, at monthly intervals during the growing season.

(c) Remove weeds and replace soil if necessary.

(d) Water regularly: The turf shall not be allowed to dry out for at least three weeks after laying, then it shall be watered normally. 'Normal' watering shall commence when the root zone moisture is depleted to 50% and shall ensure full re-wetting of the root zone to 200mm depth. In summer this will require watering at least daily. Watering shall normally be carried out prior to 7am and shall not be done in hot sunny conditions.

(e) Initial mowing shall be carried out when first growth is apparent, with blades set no lower than two-thirds of the height of the grass. Use roll-type mower for first cuts. Grass shall be in a reasonably dry condition. All clippings shall be collected and removed from site. All clippings shall also be removed from adjacent hard surfaces.

(f) Edges of all turf areas adjoining cultivated gardens, borders, hand paving, sealed surfaces or landscape structures shall be trimmed to the edge or controlled by herbicide to within 25mm of flat surfaces or 50mm of vertical structures. Grass shall not be allowed to encroach over flat paved or sealed surfaces by more than 25mm.

Areas of turf where there has been a poor establishment shall be re-laid at the Contractor's expense.

7.13.8 Chemical Applications (Weed and Pest Control)

All chemical weed and pest control shall be in accordance with 7.11. Weed control, apart from edge maintenance, shall be by manual not chemical means.

7.13.9 Defects Liability Period

After initial establishment, during and at the end of the two (2) year defects liability period, the following minimum standards shall be maintained:

- All kerb-and-channelled verges shall have grass growth no more than 50mm high, non kerb-and-channelled verges shall have grass growth no more than 200mm high and banks shall have grass growth not more than 250mm high.
- The sward shall be maintained in a healthy, weed-and-disease free state without bare patches.

- Trees and other plantings shall be protected from damage by maintenance or mowing operations and if damaged shall be reinstated within 1 week of the damage occurring.
- Maintenance and mowing operations shall be carried out at times which minimise disruption to the public.
- Maintenance and mowing operations shall be carried out only in conditions with equipment that ensures maintenance of good soil structure, minimum deformation of ground surfaces and ongoing establishment of the grass sward.
- Litter shall be removed prior to commencing maintenance or mowing operations. Highly visible shredded litter shall be removed following maintenance and mowing.
- Grass clippings, when not required to be collected during mowing, shall be spread evenly over the sward.

7.14 LANDSCAPE STRUCTURES INSTALLATION

7.14.1 General

All landscape installations shall be constructed to the appropriate standards (including legal, national or Papakura District Council standards) and according to good practice within the relevant industry.

All installations shall use good quality, low maintenance materials.

At the completion of the work the site must be clean and free of debris.

7.14.2 Fencing

Disturbance of or inconvenience to existing farming activities caused by contract works or traffic shall be minimised at all times. In some cases this may require erection of suitable fencing. Gates, other fences, and water supplies shall be protected from damage by contract activity and reinstated immediately if damaged. Access of stock to water shall not be interrupted at any time.
The Contractor shall initiate discussion with the Engineer before commencing the fencing operation to clarify style, details, variations and the like.

Stock Proof Fence
The stock proof fence shall be a durable fence which achieves the required purpose of preventing access of all livestock to the contract works area.

At road frontages the fence shall meet the following minimum standard:

- Strainers No. 1 2.4m long with stay
- Angles No. 1 2.1m long with stays (if required) at fence line
- Stays No. 2 2.4m long
- Posts No. 2 1.8m long placed at 4.5m c/c max

- Battens 50 x 40 equidistant placing, 0.8m maximum spacing
- Wire High tensile wire, 8 wires

The wires shall be facing the roadside with posts and battens behind.

Strainers shall be set to lean away from the angle of the fence to some extent or at worst be vertical upon completion of the tensioned fence.

In poor soil conditions or variable topography, longer posts, longer strainers and more substantial footings and stays shall be used where necessary to achieve a stable fence.

Additional works/materials due to poor soil conditions are a variation. Anchor or support posts required due to topography are not a variation.

All waste, particularly wire off cuts and the like shall be collected and removed from the site at completion of the fence.

Temporary Stock Proof Fence
The temporary stock proof fence shall achieve the purpose of preventing access to all livestock as required by the adjacent land users, for the duration of the required fence, or the duration of the contract.

At road frontages, no hot wires shall be used unless they are attached at 300mm inside a physical barrier.

The consequences of stock escaping due to inadequate fencing shall be the Contractor's responsibility.

Temporary fences shall be removed from the site at the completion of the contract.

7.14.3 Defects Liability Period

During and at the end of the defects liability period the following minimum standards shall be maintained:

- All permanent or temporary landscape structures shall be structurally sound, safe, function or operational and in a presentable finished form.
- Paint work and other finishes shall be maintained in a clean and presentable finished form. Bolts and other fixtures shall be maintained sound and without loose parts or rough edges.
- All structures shall be free of litter, graffiti, grime, weeds and plant growth or any other foreign matter.
- Borders, footing edges or paving shall be maintained so that no more than 25mm of grass or other vegetation is allowed to encroach. Vertical elements without mowing edges shall have vegetation maintained clear of the structure by no less than 25mm and no more than 75mm.

7.15 LANDSCAPE ENGINEERING STORMWATER DEVICES

Refer to Part 4: Stormwater, Section 4.15.

PART 8: POWER, TELEPHONE AND GAS

8.1 SCOPE

The technical specifications of the network utility organisations shall be deemed to be an appendix to this code.

8.1.1 General Requirements

(a) The developer is required to make all arrangements with the appropriate authorities for the supply and installation of electric power, and to the extent applicable for the provision of telephone and gas reticulation.

(b) **Electric Power**
The supply of electric power shall generally be made by means of an underground system. Ducts shall be installed at the time of road construction to the requirements of the network utility operators. Sites for power transformers and switching stations shall be provided as and where required. Power transformers shall not be placed over other services in the berm.

Adequate provision shall be made for road lighting to all roads within the development.

Access to power line support structures is necessary for maintenance purposes and as provided for by the Electricity Act 1992. Because this access may require the use of heavy vehicles, development plans should be discussed at an early stage with the network company concerned. Consultation should also be sought on the likely effect of power conductors above future buildings.

(c) **Telephone**
Arrangements shall be made with Telecom New Zealand for the telephone reticulation. 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 developer at the time of road construction for installation in the carriageway formation at locations where cables may be required at a later date.

(d) **Gas**
Where an existing gas supply is within 100 metres of a development, the developer shall arrange for gas reticulation within the development unless it can be demonstrated that it is not practicable or economically feasible to do so.

8.1.2 Approval Conditions

Before a Certificate of Compliance is issued, either the relevant reticulated services shall have been completed or the developer shall provide satisfactory evidence to the Council that the network utility operator is prepared to reticulate the development and that agreement on the financial arrangements for the installation of the supply has been reached.

8.1.3 Licensed Network Operators

Network services shall be installed, operated and maintained by licensed network utility operators and the developer shall certify which licensed network utility operator such network services within the development have been vested in for installation, operation and maintenance.

Should the vesting of network services within a development rest with a licensed network operator other than the owner of a network to which such network services are to be connected, Council will require written confirmation of the following, prior to issuing a certificate of completion.

(a) That agreement has been reached with the licensed owner of the network to which the development network is to be connected and that a connection can be made available to the boundary of the development; and

(b) That agreement has been reached that all the needs of the licensed owner of the network to which the development network is to be connected have been met for future extension to that network including increased capacity.

8.1.4 Underground Cabling

Where the supply is by underground means the cable laying shall be facilitated by the installation of pipe ducts. These are to be installed by the developer at road crossings in the positions required by the network utility operator. Duct pipes in the line of a proposed cable may also be required under paved drives, private ways, and accessways if the installation of the paving cannot be deferred until after the installation of the cables. Materials for ducting and the sizes of ducts shall comply with the requirements of the network utility operator.

Where a water or gas main is on the kerb side of a proposed cable, delaying the installation of service connection pipes will facilitate laying of the cable.

Copies of the scheme plan of the subdivision shall be forwarded by the developer to the network utility operator at an early date to facilitate the design of the reticulation.

It is important that the network utility operator be advised by the developer of any amendments to the scheme 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.

In preparing the engineering plans due regard shall be given to the requirements of the network utility operator as to:

(a) Minimum cover to cables.

(b) The network utility operator's desired position for the cable within the road berm.

(c) The minimum separation distances between power or telephone cables, and gas or water mains.

(d) The width of berm which must be clear of other services and obstructions to enable efficient cable laying operations.

Reference should be made to each network utility operator for their specific requirements.

8.1.5 Power Transformers, Switching Stations and Other Services

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

8.1.6 Conversion to Underground on Existing Roads

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

8.1.7 Industrial and Commercial Developments

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

8.2 LOCATION AND BACKFILLING OF SERVICES

8.2.1 Location

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

8.2.2 Backfilling of Trenches

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