



PART 4

DRAINAGE





PART 4: DRAINAGE

401 STORMWATER DRAINAGE

401.1 *General*

The stormwater drainage system shall be available to any building site within urban development or subdivision.

The subdivider or developer shall also provide for drainage or upstream catchments, and mitigate the effects of the development on downstream land or properties owned or occupied by other persons.

401.2 *Water and Discharge Permits*

401.2.1 Water and discharge permits from the Regional Council will generally be required for the following work:

The diversion of natural water during construction work.

The permanent diversion of natural water as a consequence of the development.

The discharge of stormwater.

401.2.2 In the case of diversion of natural water during construction, the necessary water permit shall be applied for by the developer or subdividing owner and is to be exercised in the name of the owner.

401.2.3 The water permit in respect of the permanent diversion of natural water will be exercised in the name of the local authority if not immediately, then once the development or subdivision has been accepted as complete by the local authority. It will be a matter of negotiation between the owner and the local authority on who will make the application and what form it should take in the first instance.

401.2.4 The discharge permit covering the discharge of stormwater will be exercised in the name of the local authority and again it will be a matter of negotiation between the developer or subdividing owner and the local authority on who will make the application and what form it should take.

401.2.5 A general authorisation may have been issued by the Regional Council to cover permanent diversions of natural water and discharges of stormwater within certain limits. The advice of the Regional Council should be sought on all water permit matters, at the earliest stage of planning the subdivision or development.



401.3 *Design Requirements*

401.3.1 The land drainage system shall be capable of serving the entire catchment upstream of the subdivision or development and with due regard to the effect it may have on downstream waterways and adjoining areas and shall be designed within the terms of any approved comprehensive drainage scheme. There should be early consultation with the Regional Council.

401.3.1.1 Primary and Secondary Flow Paths

The primary flow path for flood waters shall be a system of stormwater pipes and drainage channels designed to cope with the runoff from the design flood.

The secondary flow path is the route taken by floodwaters when the primary path is unable to cope either because of blockages or because the hydraulic capacity of the primary path is exceeded by a larger than design flood.

In designing the stormwater system, the primary and secondary flow path shall be considered to ensure that a flood protection system is designed which provides a minimum standard of protection according to the following criteria. The more stringent design requirements between this Code and NZS 4404:2004 shall apply.

| Location/ Needs | Return Period | Previous Standard |
|---|---------------|-------------------|
| Minimum requirement for culverts under local roads. | 5 Years | 1 Year |
| Culverts and drains abutting collector and no exit local roads. | 5 Years | 2 Years |
| Minimum standard for any principal piped and open channel stormwater system in urban residential areas and rural arterial roads which affects vehicle access. | 10 Years | 5 Years |
| Protection of important recreational fields and roads without alternative access. | 20 Years | 10 Years |
| Stormwater systems that protect residential, commercial and industrial buildings. | 50 Years* | 50 Years |
| Protection of major communal facilities related to the supply of electricity, water, telephone, gas and sewerage disposal. | 100 Years* | 100 Years |
| * risk assessment required to identify whether additional protection would provide greater benefit-cost. | | |



- 401.3.2 The design calculations shall be in accordance with the New Zealand Institution of Engineer's Procedure for hydrological design of urban stormwater systems, or other accepted design procedure.
- 401.3.3 Rainfall Intensity. The rainfall intensities to be used for calculating Urban runoff shall be taken from the following Table 2.

Table 2: Duration/Intensity of Rainfall

| Duration of Storm (minutes) | Intensity (mm/hr) | | | | |
|-----------------------------|-------------------|------|-------|-------|--------|
| | 2 yr | 5 yr | 10 yr | 50 yr | 100 yr |
| 10 | 72 | 96 | 114 | 156 | 174 |
| 20 | 51 | 69 | 84 | 114 | 126 |
| 30 | 42 | 58 | 70 | 96 | 106 |
| 40 | 35 | 47 | 58 | 79 | 89 |
| 50 | 30 | 41 | 50 | 68 | 77 |
| 60 | 27 | 36 | 44 | 60 | 68 |

- 401.3.4 Where open watercourses are to form part of the land drainage system the subdivider or developer shall submit sufficient engineering design to enable Council to evaluate the proposals.
- 401.3.5 Each stormwater connection shall be capable of serving the whole of the building area of the lot, except where this requirement seems unreasonable and can be shown that the proposed connection is adequate for a pre-determined building location and floor plan.
- 401.3.6 The stormwater connection shall generally be to a piped stormwater system but where the topography permits, the stormwater from a limited number of houses may be piped to the road channel or to the back of the road sump, subject to approval by the Engineer.
- Where the ground conditions are suitable (except in tomo prone areas) and subject to the prior approval of the Engineer, a system of stormwater disposal by soakage into the ground may be both desirable and practicable.
- Where further subdivision or development, upstream of the one under consideration, is provided for in the District or Regional Plan, the Engineer may require stormwater pipelines to be constructed to the upper limits of the subdivision or development.

401.4 Open Watercourses

- 401.4.1 Major watercourses should preferably be retained, and be located in public reserves. Piping more than dry weather flow in large watercourses is often unnecessary and uneconomic.
- 401.4.2 The extent of stream improvement work shall be agreed with the Engineer in order to achieve a satisfactory compromise between the retention of the natural topography and vegetation, and maintenance, hydraulic and safety considerations, including the downstream effects of the work.



401.5 *The Hydraulic Design of Pipelines*

No stormwater pipe other than connections should be less than 225mm diameter.

The pipe roughness coefficient k_s used in the hydraulic design should be 1.5mm.

401.6 *Location of Pipelines*

401.6.1 Stormwater drainage pipelines should be sited in accordance with the normal pattern required by the Council, in the road reserve or in areas which will not reduce the building area available on the lot (that is, within the front, side or rear yard areas) or it should be able to be shown that a satisfactory house siting is available clear of the drainage lines.

401.6.2 Manhole structures should be clear of all boundary lines.

Where the gradient of the pipeline is steep, generally not less than 10%, or the ground conditions, or both, in the opinion of the Engineer, merit the need, sufficient cement should be added to the granular bedding material to provide a weak concrete with a strength of not less than 7 MPa. The depth of bedding should be as for Type B described in NZS 4452 and should be broken at the pipe joint to maintain flexibility.

Where the pipeline gradients are equal to or greater than 20%, the Engineer may require anti-scour blocks to be constructed of ordinary grade 17.5 MPa cast in situ concrete blocks of a type illustrated in fig. 11 of the Code, to be constructed but they should extend 150mm over the top of the pipeline.

401.7 *Pipes*

401.7.1 The following pipes may be used for stormwater drainage work, provided they comply with the relevant New Zealand Standard:

- (i) Concrete pipes to NZS 3107.
- (ii) Ceramic pipes to NZS 1823.
- (iii) uPVC pipes to NZS 7649:1988
- (iv) Helical Lock Seam Corrugated Steel Pipes NZS 4405:1986.

401.7.2 Other pipes may be permitted subject to the specific approval of the Engineer.

401.8 *Joints*

401.8.1 All pipes less than 750mm diameter should have an approved flexible sealed joint. Pipes 750mm diameter and larger may have approved flush joints.

401.8.2 Flush jointed pipes should normally be adequately sealed with cement mortar. Any joints deliberately left unsealed to allow subsoil drainage should have the joints surrounded by granular material of an appropriate filter grading, or approved filter fabric, in order to prevent the entry of silt or clay into the pipeline.

401.9 *Structural Strength of Pipes and Bedding*

401.9.1 The pipe bedding should be selected to meet the requirements of the class of pipe to be used and the design loading conditions.



- 401.9.2 The type of bedding and class of pipes adopted should be in accordance with the pipe laying tables and bedding diagrams in NZS4404:2004 figures CM 001 – CM 003 except that a specific design may be required for flush jointed pipe bedding.
- 401.9.3 Under normal ground conditions pipes, except uPVC, should be bedded and haunched with fine granular material, as for Type 2 bedding, as set out in NZS 4404:2004 fig. CM 002.
- 401.9.4 The requirements for PVC should be as set out in NZS 4404:2004 fig. CM 002.
- 401.9.5 *Where a pipeline is to be constructed through soft ground in unsuitable foundations such material should be removed and replaced with other approved material or alternatively, other methods of construction should be carried out to the approval of the Engineer to provide an adequate foundation for the pipeline.*

401.10 Pipeline Construction

- 401.10.1 The construction of pipelines should be carried out in accordance with the requirements of NZS 4452, and NZS 7643.
- 401.10.2 Where possible, pipelines constructed on slopes which are steep and/or may be prone to instability, should be laid parallel to the direction of natural slope. Where this is not possible, care should be taken to limit the depth of excavation and control of local surface water drainage.

401.11 Minimum Cover over Pipes

- 401.11.1 General. All pipelines should be specifically designed to support the likely loadings in relation to the minimum cover to be provided in accordance with the terms of NZS 4452. The minimum cover for all types of pipes under all conditions should be 600mm except as otherwise required by 401.11.2 and 401.11.3.
- 401.11.2 *Private Property*
- 401.11.2.1 The minimum cover over unreinforced pipes in private property should be 500mm. Where due to the topography this cover cannot be provided, reinforced or unreinforced concrete protection should be provided for the pipelines to the satisfaction of the Engineer.
- 401.11.2.2 Where the reticulation lines are located in the front yard of lots the invert level should be deep enough not to interfere with any future driveway construction.

401.12 Manholes

- 401.12.1 General. Manholes should normally be provided at each change of direction or gradient, and at each branching line and at a spacing of not more than 100m. Manholes may be either cast in situ or of precast concrete.
- 401.12.2 All manholes should have a heavy duty cover and frame of approved manufacture.



401.12.3 Standard Manholes

401.12.3.1 These should be circular manholes with a minimum internal diameter of 1,050mm and are to be used on pipelines up to and including 600mm diameter.

401.12.3.2 Cast in situ manholes should be constructed using Ordinary Grade concrete (17.5 MPa) vibrated to give maximum density and watertight construction.

401.12.3.3 Precast manholes should consist of centrifugally spun 1,050mm diameter concrete pipes to Class S standard. They should have holes cast in the side for step irons.

The method of joining the precast sections should be strictly in accordance with the recommendations of the precaster, and when using a proprietary jointing compound or adhesive, in conformity with the manufacturer's instructions, to provide a watertight structure to the satisfaction of the Engineer.

401.12.4 Deep Manholes

401.12.4.1 Where manholes are more than 5m deep they should be specifically designed and should incorporate intermediate landing platforms for grills in order to prevent a free-fall of more than 5m.

401.12.5 Shallow Manholes

401.12.5.1 A typical example of a shallow manhole with mini and drop manhole details is illustrated in fig. CM-005, NZS 4404:2004.

401.12.6 Stormwater Manholes on Larger Pipelines

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

401.12.6.2 For deep special manholes it may be more economical to construct the lower portion to the required larger dimensions with the standard 1,050mm diameter riser supported on a reinforced concrete slab on the lower large diameter chamber.

401.12.6.3 The use of fixed steel ladders instead of separate step irons may be economical, or otherwise desirable. Recessed steps without rungs may be permitted below pipe benching level, provided the lower rung can be easily reached by a person standing at invert level.

401.12.6.4 On stormwater pipelines equal to or greater than 1m diameter, the spacing of manholes may be extended to up to 200m and curvature on the pipeline may be permitted providing that joint deflections are within the limits of the manufacturer's recommendations. Any pipeline curvature should be the subject of specific approval by the Engineer.

401.12.6.5 Manholes on straight sections of stormwater lines of 1.2m diameter and above may be constructed using offset intakes which may also be used in conjunction with bends, formed using epoxy mortar adhesive.



401.12.7 Hydraulic Flow in Manholes

401.12.7.1 In addition to the normal pipeline gradient, all manholes should have a minimum drop of 205 mm per 10° of the angle of change of low within the manhole. Manholes on pipelines greater than 1m diameter should have the drop through the manhole designed to compensate for the energy lost due to the flow through the manhole at the design radius.

401.12.8 Manhole Requirements

Cesspits leads up to 300mm diameter may be saddled on to pipelines 900mm diameter or larger.

401.12.9 Step Irons, Steps and Ladders

401.12.9.1 All manholes other than shallow manholes should be provided with approved galvanised steel step irons, steps or ladders in order to give reasonable access. Step iron should be of the 'dropper' or 'safety' type such that a foot will not slide off them, and shall be spaced as shown on fig. CM-004NZS 4404:2004. All fittings used shall be hot-dip galvanised after fabrication.

401.12.10 Manhole Covers and Frames

401.12.10.1 Manhole covers and frames shall be of a design approved by the Engineer, manufactured from a strong and durable material. Typical examples of heavy duty, light duty, and screwdown covers supplied in high quality grey iron, coated with a bituminous protective compound are illustrated in figures CM-004 to 006 NZS 4404:2004.

401.12.11 Drop Connections

401.12.11.1 Drop connections on stormwater manholes may be avoided by allowing pipes up to and including 300mm diameter to have an open 'cascade' inside the manhole, providing the steps are clear of any cascade.

401.12.12 Manholes in Soft Ground

401.12.12.1 Where a manhole is to be constructed in soft ground, the area under the manhole should be undercut down to solid and back-filled with suitable hardfill to provide an adequate foundation for the manhole base.

401.13 Connections

401.13.1 The connection provided for each residential lot shall be of a type capable of taking the spigot end of an approved drainpipe of 100mm internal diameter unless the Engineer requires a larger size connection to be provided.

401.13.2 The subdivider shall provide stormwater connections to individual industrial and commercial subdivision lots.

401.13.3 Where the stormwater sewer is outside the lot or property to be served, a 100mm diameter connection should be extended to the boundary of the lot.

Where the connection will cross more than one lot boundary, the prior approval of the Engineer should be obtained before the installation is made.



- 401.13.4 If the above conditions cannot be met, then the connection should be a 150mm diameter line branching from a manhole in the main line. An extended 150mm diameter connection may be terminated without a manhole provided it is not more than 40m long (or possibly longer at the discretion of the Engineer) and also that it does not serve more than two houses, otherwise a manhole should be provided.
- 401.13.5 Where the design data is available, connections for commercial and industrial lots should be designed to take the full design flow from the area served by the connection.
- 401.13.6 Where required by the Engineer, each connection shall be marked by a 50mm x 50mm timber stake (treated pine or better) extending to 600mm above ground level with the top painted blue. This marker post shall be placed alongside a timber marker installed at the time of pipelaying and extending from the connection to 150mm below finished ground level. The lower end of the marker post shall be adjacent to, but not touching the connection. Connections shall be accurately indicated on "as built" plans.
- 401.13.7 All connections whether to reticulation lines or to manholes should be sealed either by a factory sealed stopper or a plug fixed with a rubber ring and held with stainless steel wire.

401.14 Ramped Risers

- 401.14.1 Unless required otherwise by the Engineer, where a connection is deeper than 1.8m below ground level, a ramped riser should be constructed to bring the connection to within 1.2m of ground level.
Ramped risers should be constructed in terms of good drain laying practice; a typical example is illustrated in fig. 11 of the Code.
- 401.14.2 Where an extended connection is to be taken from a sewer 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.

401.15 Connections to Deep Lines

- 401.15.1 Where an existing or proposed stormwater pipeline is more than 5m 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.

401.16 Inlet and Outlet Structures

- 401.16.1 Approved type structures shall be constructed at the inlets and outlets of pipelines. An acceptable type of concrete structure is shown on fig. 12 of the Code. Provision must be made for energy dissipation unless it is demonstrated by the subdividing owner that outlet velocities and soil conditions are such as to make this unnecessary. The design shall ensure non-scouring velocities at the point of discharge.



401.17 **Testing**

401.17.1 The pressure testing of stormwater sewers 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.

402 **SANITARY DRAINAGE**

402.1 **General**

Unless otherwise approved, all allotments shall be provided with a connection to a sanitary drainage system.

The sanitary drainage system should be designed to serve the whole of the natural upstream catchment area. However, where part or all of the catchment is serviced or will be served by a trunk sewer to be constructed at a later date, the Engineer may agree to this area being excluded from the calculation. The flow from all portions of the upper catchment within the regional urban boundary shall be calculated assuming complete urbanisation except for those areas permanently set aside for recreation reserves.

Where further subdivision or development, upstream of the one under consideration, is provided for in the District Plan, the Engineer may require sewer pipelines to be constructed to the boundaries of the subdivision or development.

In cases where substantial costs are likely to be incurred in providing extended sewer lines that will not serve the subdivision or development under consideration, the Council may contribute towards these costs.

402.2 **Calculation of Flows**

402.2.1 Sewerage flows are a function of water consumption, infiltration and direct ingress of stormwater, which in turn are a function of the age of the system and the quality of maintenance. Council should collate flow data to enable flows to be reviewed on the basis of reliable information.

402.2.2 *Domestic Flows*

Domestic sewerage flows can be calculated on the basis of an average dry weather flow of 180 to 210 L per day per person. A dilution factor of 2 for wet weather and a peaking factor of 2.5 are recommended. Variable peaking factors may be required by the Engineer.

A high peaking factor may be appropriate for a small catchment but too much for a large catchment where peaks are less pronounced. Due allowance needs to be made for the land use.

402.3 **Industrial Domestic Flow and Trade Wastes**

402.3.1 Where the industrial domestic waste and trade waste flows from a particular industry are known, these shall be used as the basis for the sewer design. When the above information is not available, the following may be used as a design basis:



| Industry type (water usage) | Minimum design flow (litres/second/hectare) |
|--------------------------------|--|
| Light | 0.4 |
| Medium | 0.7 |
| Heavy | 1.3 |

The above design flows include both normal sanitary sewage and trade wastes.

- 402.3.2 The industry type will not necessarily coincide with the zoning classification shown in the district scheme, but the zoning, particularly where effluent discharge is a performance standard, may be used to indicate the minimum design flow where more detailed information is not available.
- 402.3.3 It may be desirable to provide additional capacity if the subdividing owner wishes to widen the range of industries which are to be located in the subdivision. However, the capacity of the existing receiving facility may be a controlling factor.
- 402.3.4 The design of sewage disposal system for 'wet' industries (very heavy water users), is to be based on the specific requirements for that industry.

402.4 *The Hydraulic Design of Pipelines*

- 402.4.1 The hydraulic design of sanitary sewer pipelines shall be based on Hydraulics Research Paper No. 4, Tables for the hydraulic design of stormwater drains, sewers, and pipelines, or on graphs or other representation of the same method, or on Mannings formula.
- 402.4.2 *Hydraulic Design*
The minimum diameter shall be 150mm for public drains, and 100mm for residential connections. For the purposes of this clause, a public sewer is one servicing more than two lots and marked with a terminal manhole.
A rodding eye shall be provided at the end of any connection longer than 12m.
An inspection wye pipe shall be provided at the junction of any sewer serving two dwelling units.
- 402.4.3 The pipe roughness coefficients k_s used in the design shall be those nominated by or agreed upon with the Engineer on the basis of commonly adopted modern engineering design practice. For preliminary design purposes it is recommended that k_s be assumed 1.5mm as an overall coefficient allowing for joints and so on.
- 402.4.4 The desirable flow velocity in 150mm diameter pipes when full shall normally be not less than 0.65 metre/second (minimum gradient 0.55%), but 0.75 metre/second (minimum gradient 0.72%) shall be the desirable minimum velocity for the upper portions of sanitary sewer systems.
- 402.4.5 Gradients flatter than 0.55% for 150mm diameter pipes may be permitted in special cases where otherwise pumping would be required.
- 402.4.6 A 150mm diameter pipeline at a gradient of 0.75% has 14 litre/second capacity (equivalent to 300 houses or 1,200 people).



- 402.4.7 A 150mm diameter pipeline at a gradient of 0.55% has 12 litre/second capacity (equivalent to 257 houses or 1,030 people).
- 402.4.8 In practical terms, unless the catchment exceeds 250 houses, dwelling using, or their equivalent, and where no flow from a pumping station is involved, 150mm diameter pipes laid within the above limits will be adequate without specific hydraulic design.
- 402.4.9 In flat or rolling country, every effort should be made in the design to have the sewers as steep as reasonably possible.

402.5 Location of Pipelines

- 402.5.1 Sanitary drainage pipelines shall be sited in accordance with the normal pattern required by the Council, in the road reserve or in areas which will not reduce the building area available on the lot (that is, within the front, side or rear yard areas) or it shall be able to be shown that a satisfactory house siting is available clear of the drainage lines.
- 402.5.2 Manhole structures shall be clear of all boundary lines.

402.6 Pipes

- 402.6.1 Ceramic or concrete pipes may be used for sanitary drainage provided they comply with the relevant New Zealand Standards as follows:
- NZS 1823 Ceramic sewer pipes
- NZS 3107 Precast concrete drainage and pressure pipes
- Pipes manufactured from other materials such as PVC may be used provided the prior approval of the Engineer has been obtained.
- 402.6.2 In potentially unstable ground or where special protection is required, the sewer pipelines should be specifically designed.
- 402.6.3 Steel pipes should be used where additional strength is required, however, the construction of pipelines on steep gradients, at shallow depths or under carriageways are not necessarily criteria requiring the use of steel pipes.
- 402.6.4 Steel pipes shall be to NZS 4443 and shall have a spun concrete lining not less than 6mm thick, and an approved external protective coating. Care shall be taken to ensure that the concrete lining remains undamaged.
- 402.6.5 UPVC pipes may be used for 100mm and 150mm diameter sewers, subject to the specific approval of the Engineer. The pipes, fittings and pipe laying shall comply with the relevant standards as follows:
- NZS 7649
- NZS 7643
- 402.6.6 Before approving the use of PVC pipes, the Engineer will require details of the methods of jointing, the method of providing connections to other pipes and manholes, the bedding and surrounding materials to be used, and similar details. The trench width at the top of the pipe must be kept



to a minimum and particular care must be taken that the pipe is correctly aligned and not disturbed by the backfilling operation.

402.7 Joints

- 402.7.1 All pipes shall have flexible joints of an approved type and complying with the relevant New Zealand Standard. Rubber ring joints shall be to NZS/BS 2494. Rubber sleeve joints with stainless steel wire ties will be allowed only in special cases, and with specific approval by the Engineer. Steel pipes may be either flange jointed or flexible (gibault or approve rubber ring). Gibault joints shall be of an approved manufacture, and shall have galvanised steel bolts.
- 402.7.2 Other methods of flexible jointing shall be to the specific approval of the Engineer.
- 402.7.3 Joints shall be provided adjacent to manholes to the requirements of NZS 4452.
- 402.7.4 Mortar joints will be permitted only in exceptional circumstances and with specific approval of the Engineer.

402.8 Structural Strength of Pipes and Bedding

- 402.8.1 Pipe bedding will be designed to meet the requirements of the class of pipe used under the design loading conditions.
- 402.8.2 The type of bedding and class of pipe should be in accordance with the pipelaying tables and bedding diagrams in NZS 4404:2004.
- 402.8.3 The requirements for PVC pipes should be as set out in NZS 7643 and SAA CA 68.
- 402.8.4 Under normal ground conditions, sewer pipelines should be bedded with fine granular material as in NZS 4452 except that in lieu of the construction of a specified depth of selected compact fill, the granular material may be haunched up to a height level with the mid height of the external diameter of the pipeline.

Where the gradient of the sewer pipeline is steep (generally greater than 10%), or where in the opinion of the Engineer, ground conditions merit the need, sufficient cement should be added to the granular bedding material to provide a weak concrete with a strength of not less than 7 MPa.

Where the pipeline gradients are equal to or greater than 20%, the Engineer may require anti-scour blocks to be constructed or ordinary grade 17.5 MPa cast in situ concrete blocks of a type comparable to that illustrated in fig. 11 of the Code. The recommended spacing for the blocks is 7m.

Where the pipeline gradients are equal to or greater than 33%, the Engineer may require similar anchor or anti-scour blocks to be constructed but they shall extend 150mm over the top of the pipeline of a type illustrated in fig. 11 of the Code.



402.8.5 Where a pipeline is constructed through soft ground, the area under the pipes should be undercut down to solid ground and backfilled with suitable material to provide adequate foundations for the pipe bedding.

Alternatively, such other means of providing a satisfactory foundation and support for the pipeline as may be approved by the Engineer, shall be adopted.

402.9 Pipeline Construction

402.9.1 The construction of the pipelines shall be carried out in accordance with the requirements of NZS 4404:2004.

402.10 Minimum cover over pipes

402.10.1 Private Property

402.10.1.1 The minimum cover over unreinforced pipes in private property shall be 500mm. Where due to the topography, this cover cannot be provided, approved protection shall be provided for the pipeline.

402.10.1.2 Where the reticulation lines are located in the front yards of lots, the invert level shall be deep enough so as not to interfere with any future driveway construction.

402.10.2 Under Carriageways

402.10.2.1 Reinforced pipes shall be specifically designed to support the pavement design loading appropriate to the minimum cover to be provided.

402.10.2.2 Unreinforced pipes with an invert level less than 1.2m below road subgrade level shall be protected with fine granular backfill and may be protected by precast 'indicator slabs' as in fig. 11 of the Code or by a concrete surround.

402.11 Manholes

402.11.1 General

402.11.1.1 Manholes shall normally be provided at each change of direction or gradient, and at each branching sewer, and at a spacing of not more than 100m. Manholes may be either cast in situ or precast.

402.11.2 Standard Manholes

402.11.2.1 These are to be circular manholes with a minimum internal diameter of 1,050mm.

402.11.2.2 Cast in situ manholes shall be constructed using ordinary grade concrete (17.5 MPa) well vibrated to give maximum density and watertight construction.

402.11.2.3 Precast manholes shall consist of centrifugally spun 1,050mm diameter concrete pipes to Class 'S' standard. They shall have holes cast in the side for step irons.

The method of jointing the precast sections shall be strictly in accordance with the recommendations of the precaster, and when using a proprietary joining compound or adhesive, in conformity with the manufacturer's



instructions to provide a watertight structure to the satisfaction of the Engineer.

402.11.3 Deep Manholes

402.11.3.1 Where manholes are more than 5m deep they shall be specifically designed and shall incorporate an intermediate landing platform or grill in order to prevent a free fall of more than 5m.

402.11.4 Shallow Manholes

A typical example of a shallow manhole is illustrated in fig. 11 of the Code.

402.11.5 Steps Irons and Steps

402.11.5.1 All manholes other than shallow manholes shall be provided with approved step irons or steps in order to give reasonable access. These should normally be of the 'dropper' or 'safety' type such that a foot will not slide sideways off them, and shall be spaced as shown on fig. CM-004 NZS 4404:2004.

402.11.6 Manhole Covers and Frames

Manhole covers and frames shall be of a design approved by the engineer, manufactured from a strong and durable material. Typical examples for heavy duty, light duty, and screwdown cover supplied in high quality grey iron, coated with a bituminous protective compound are illustrated in figures CM-004 to 006 NZS 4404:2004.

402.11.7 Drop Connections

Drop connections at manholes may be constructed either externally or internally in a manner similar to the illustrations in figures CM-004, 005 NZS 4404:2004. Where internal drops are used, the engineer may require the internal diameter of the manhole to be increased.

402.11.8 Manholes in Soft Ground

402.11.8.1 Where a manhole is to be constructed in soft ground, the area under the manhole shall be undercut down to solid and backfilled with suitable hardfill to provide an adequate foundation for the manhole bases.

402.12 Connections

Where the sanitary sewer line is outside the lot to be served, a connection shall be extended to 300mm inside the boundary of the lot.

Connections shall be provided to serve each lot such that the minimum grade of the private drains shall be 1.25% with 500mm cover over the likely building site.

In the case of more than one rear allotment, the service connection will not be permitted to stop at the road boundary but must be laid along the right-of-way to where this joins the section proper.

Household connections to each allotment shall be laid generally 45° or 90° to the boundaries unless permission to the contrary is obtained from the Council. Connections shall be located to suit the siting of future houses where these are known, but otherwise at the lowest point on the front boundary at least 0.5m from the side boundary and within 1.2m of finished ground level.



Each connection shall be marked by a 50mm x 50mm timber stake with the top painted red extending from below invert level to 600mm above ground level.

Where a house connection is laid through one lot to another lot then the subdivider shall obtain a drainage easement for the first lot.

Pipes which have rubber ring joints shall be connected to the foul sewer by means of a London Junction or a 45° Y-junction and a bend with the 100mm branch of the Y-junction rising away from the sanitary sewer and being supported by concrete underneath it. The Y-junction shall be set no less than 45° above the horizontal.

402.13 Ramped Risers

402.13.1 Unless required otherwise by the Engineer, a ramped riser shall be constructed to bring the connection to within 1.2m of ground level.

402.13.2 Ramped risers shall be constructed as shown in fig. 11 of the Code.

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

402.14 Connections to Deep Lines

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

402.15 Testing

402.15.1 All sanitary sewer main and branch pipelines, including extended connections, shall be pre-tested during construction. On completion of all other engineering work within the subdivision or development, there shall be a final test witnessed by representatives of the Council and as the case may require, the Regional Council. This test shall be the low pressure air test as set out in NZS 4452.

402.15.2 No visible infiltration through manhole walls or floors will be permitted. The total infiltration in any portion of a sanitary sewer system shall not exceed a rate of 600ml per 25mm of pipe diameter per 1,000m of pipe in 5 min.

402.15.3 All tests shall be carried out in accordance with the bylaws of the Council and as the case may require, the Drainage Authority.

402.16 Pumping Stations and Treatment Plants

402.16.1 For the design of these, early consultation with the Engineer, the Regional Council, and the Health Department is essential.

402.16.2 The Engineer is concerned with all aspects of operation, maintenance, access, and security and may require the mechanical and electrical installations to be compatible with existing installations.



The Regional Council is concerned with the quality of the receiving waters for effluent from treatment plants and emergency overflows and consequently water rights will be required to cover such works. (See clauses under 401.2 covering water permits in terms of stormwater drainage for the likely procedures.)

402.17 ***Rising Mains***

402.17.1 Rising mains shall meet the requirements for the construction of principal mains as set out in Section 501, Water supply of this Code. Rising mains in private property shall be sited clear of building sites. The test pressure shall be twice the maximum working pressure.